NASA

National Aeronautics and
Space Administration

Budget Estimates

FISCAL YEAR 1987

Volume II

Construction of Facilities

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

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VOLUME II

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Project Justification by Location:

SUMMARY
INFORMATION

THIS DOCUMENT DOES NOT REFLECT: (1) THE FY 1986 REDUCTIONS THAT ARE LIKELY TO RESULT UNDER THE BALANCED BUDGET AND EMERGENCY DEFICIT CONTROL ACT OF 1985; OR (2) THE EFFECTS RESULTING FROM THE LOSS OF THE CHALLENGER AND CREW ON JANUARY 28, 1986. PROPOSED CHANGES IN PROGRAM PLANS AND BUDGET ESTIMATES WILL BE TRANSMITTED LATER.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

The Construction of Facilities (CoF) appropriation provides contractual services for the repair, rehabilitation and modification of existing facilities; the construction of new facilities; the acquisition of related facility equipment; the design of facilities projects; and advance planning related to future facilities needs.

The funds requested for 1987 provide for: the continuation of prior year's endeavors in meeting the facilities requirements for Space Flight; modification of aeronautical research and development facilities; repair, rehabilitation and modification of other facilities to maintain, upgrade and improve the usefulness of the NASA physical plant; minor construction of new facilities; and facility planning and design activities.

The projects and amounts in the budget estimate reflect Space Flight requirements that are time sensitive to meet specific milestones. Other program requirements for 1987 include the construction of a central computing facility at the Johnson Space Center; construction of a spacecraft systems development and integration facility at the Goddard Space Flight Center; construction of an engineering support building, and modification of the uninterruptible power system in the space flight operations facility at the Jet Propulsion Laboratory; construction of a human performance research laboratory at the Ames Research Center; construction of an integrated test facility at Dryden Flight Research Facility; construction of an addition for the non-destructive evaluation research laboratory, and modifications to the 8-foot high temperature tunnel at the Langley Research Center; construction of a power systems facility at the Lewis Research Center; and the construction of the second tracking and data relay satellite system ground terminal facility, New Mexico.

The FY 1987 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and ensuring safe economical and efficient use of the NASA physical plant. This request continues the necessary rehabilitation and modification program begun in prior years and continues a repair program. The purpose of the repair program is to restore facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish smaller facility projects which accommodate changes in technical and institutional requirements.

Funds requested for facility planning and design cover advance planning and design requirements for potential future projects, master planning, facilities studies, engineering reports and studies and the preparation of facility project design drawings and bid specifications.

The budget authority requested for FY 1987 is $181,300,000, with estimated outlays of $148,700,000.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPROSED APPROPRIATION LANGUAGE

CONSTRUCTIONOF FACILITIES

For construction, repair, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities. and for facility planning and design not otherwise provided, for the National Aeronautics and Space Administration, and for the acquisition or condemnation of real property., as authorized by law, [$139,300,000] *$181,300.000*, to remain available until September 30, [1988] *1989*: ***Provided,*** That, notwithstanding the limitation on the availability of funds appropriated under this heading by this appropriation Act, when **any** activity has been initiated by the incurrence of obligations therefor, the amount available for such activity shall remain available until expended, except that this provision shall not apply to the amounts appropriated pursuant to the authorization for repair, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities, and facility planning and design: ***Provided further***, That no amount appropriated pursuant to this or any other Act mag be used for the lease or construction of a new contractor-funded facility for exclusive use in support of a contract or contracts with the National Aeronautics and Space Administration under which the Administration would be required to substantially amortize through payment or reimbursement such contractor investment. unless an appropriation Act specifies the lease or contract pursuant to which such facilities are to be constructed or leased or such facility is otherwise identified in such Act: ***Provided further,*** That the Administrator may authorize such facilitg lease or construction, if he determines, [in consultation] with *notice to* the Committees on Appropriations, that deferral of such action until the enactment of the next appropriation Act would be inconsistent with the interest of the Nation in aeronautical and space activities. ***(Department of Housing and Urban Development-Independent Agencies Appropriation Act, 1986; additional authorizing legislation*** *to* ***be proposed.)***

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1987 ESTIMATES

SUMMARY OF THE BUDGET PLAN BY LOCATION

Location	FY 1985	FY 1986 (In Dollars)	FY 1987
Lyndon B. Johnson Space Center	---	---	9.000. 000
George C. Marshall Space Flight Center	I, 600. 000	---	---
Space Station Facilities	---	---	12.900. 000
Space Flight Facilities	38.800. 000	29.900. 000	3.400. 000
Space Shuttle Payload Facilities	6.700. 000	1.200. 000	---
Goddard Space Flight Center	2.200. 000	3.800. 000	8.000. 000
Jet Propulsion Laboratory	12.200. 000	8.900. 000	12.400. 000
Ames Research Center	11,500,000	8.200. 000	9.400. 000
Dryden Flight Research Facility	---	---	17.500. 000
Langley Research Center	13.800. 000	4.900. 000	11.700. 000
Various Locations	13.800. 000	17.400. 000	22.000. 000
Repair	18.000. 000	22.000. 000	24.000. 000
Rehabilitation and Modification	22.000. 000	26.000. 000	30.000. 000
Minor Construction	5.000. 000	6.000. 000	7.000. 000
Facility Planning and Design	12.000. 000	11.000. 000	14.000. 000
Total Plan	157.600. 000	139.300. 000	181.300. 000

SUMMARY OF BUDGET PLAN BY COGNIZANT OFFICE

	FY 1985	FY 1986 (In Dollars)	FY 1987
Office of Space Station	---	---	12.900. 000
Office of Space Flight	45.000. 000	31.100. 000	12.400. 000
Office of Space Science and Applications	12.200. 000	12.700. 000	20.400. 000
Office of Aeronautics and Space Technology	27.400. 000	13.100. 000	38.600. 000
Office of Space Tracking and Data Systems	16.000. 000	17.400. 000	22.000. 000
Office of Management	57.000. 000	65.000. 000	75.000. 000
Total Plan	157.600. 000	139.300. 000	181.300. 000

SUMMARY OF BUDGET PLAN BY SUBFUNCTION

Code No.				
253	Space Flight	38.800. 000	29,900. 000	10.500. 000
254	Space Science. Applications. and Technology	8.300. 000	5.000. 000	23.200. 000
255	Support Space Activities	85.200. 000	91.300. 000	118.400. 000
(250)	Subtotal. General Science. Space and Technology	132.300. 000	126.200. 000	152.100. 000
402	Air Transportation	25.300. 000	13.100. 000	29.200. 000
	Total	157.600. 000	139.300. 000	181.300. 000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1987 ESTIMATES

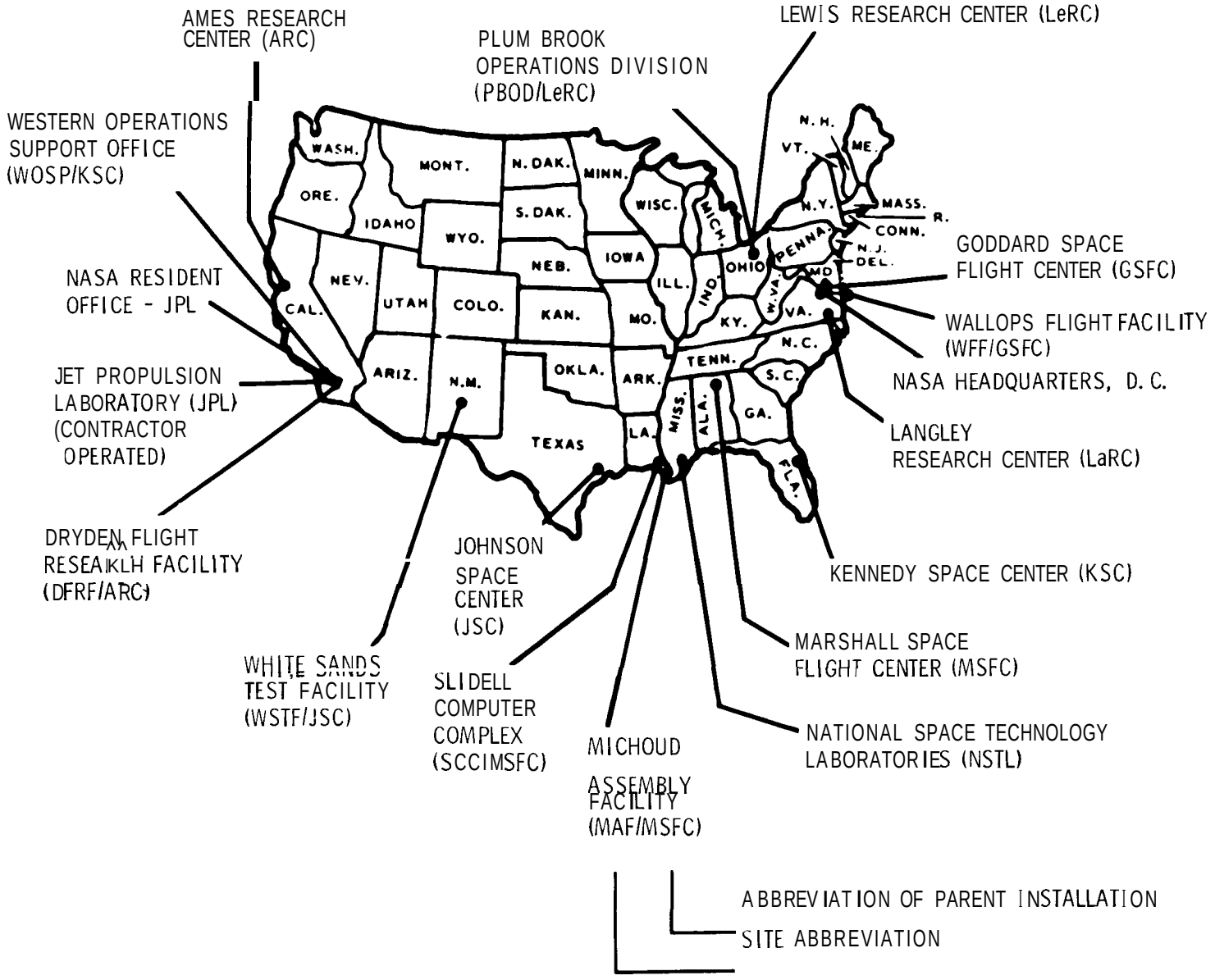
SUMMARY OF THE BUDGET PLAN BY LOCATION

Cognizant Office	Budget Activity	Subfunction Code	Location and Project	FY 1985	FY 1986	FY 1987	Page No.
				(Thousands of Dollars)			
			LYNDON B. JOHNSON SPACE CENTER.....	---	---	9,000	
SF	7	255	Construction of Central Computing Facility..	---	---	9,000	CF 1-1
			GEORGE C. MARSHALL SPACE FLIGHT CENTER.....	1,600	---	---	
SF	4	254	Repairs to Test Stand 500.....	1,600	---	---	
			SPACE STATION FACILITIES AT VARIOUS LOCATIONS, AS FOLLOWS:.....	---	---	12,900	
SS	1	253	Construction of Addition to the Systems Integration and Mockup Laboratory (JSC)	---	---	5,000	CF 2-1
SS	4	254	Construction of Power Systems Facility (LeRC)	---	---	5,800	CF 2-8
SS	1	253	Modifications to Test Stand 300 for Space Station Hydrogen/ Oxygen Propulsion Systems Development (MSFC)	---	---	2,100	CF 2-15
			SPACE FLIGHT FACILITIES AT VARIOUS LOCATIONS, AS FOLLOWS:.....	38,800	29,900	3,400	
SF	1	253	Construction of Addition to Orbiter Processing Facility Annex (KSC)	---	---	3,400	CF 3-1
SF	1	253	Construction of Orbiter Modification and Refurbishment Facility (KSC)	---	14,000	---	
SF	1	253	Construction of Thermal Protection System Facility (KSC)	---	3,600	---	
SF	1	253	Modifications for Advanced Technology Engine Test Stand S-1C (MSFC)	---	6,500	---	
SF	1	253	Modifications for Enhanced Life Support Systems Testing (JSC) ..	---	1,100	---	
SF	1	253	Modifications to Pad A Payload Change-Out Room (KSC)	---	2,200	---	
SF	1	253	Modifications to Space Shuttle Main Engine Support Systems (NSTL)	---	2,500	---	

Cognizant Office	Budget Activity	Subfunction Code	Location and Project	FY 1985	FY 1986	FY 1987	Page No.
				(Thousands of Dollars)			
SF	1	253	Construct Easter Island Runway Extension (KSC)	7,600	---	---	
SF	1	253	Construction of Launch Complex 39 Logistics Facility (KSC)	9,700	---	---	
SF	1	253	Construction of Solid Rocket Booster Assembly and Refurbishment Facility (KSC)	15,000	---	---	
SF	1	253	Modification of Site Electrical Substation (JSC)	3,200	---	---	
SF	1	253	Modifications for Single Engine Testing (NSTL)	3,300	---	---	
			SPACE SHUTTLE PAYLOAD FACILITIES AT VARIOUS LOCATIONS, AS FOLLOWS:	6,700	1,200	---	
SF	2	254	Construction of Payload Control Rooms (KSC)	---	1,200	---	
SF	2	254	Construction of Additions to Cargo Hazardous Servicing Facility (KSC)	4,600	---	---	
AST	2	254	Construction of Biomedical Research Facility (ARC)	2,100	---	---	
			GODDARD SPACE FLIGHT CENTER	2,200	3,800	8,000	
SSA	2	254	Construction of Spacecraft Systems Development and Integration Facility	---	---	8,000	CF 4-1
SSA	2	254	Construction of Addition to Research Project Laboratory..	---	3,800	---	
ST&DS	7	255	Construction of Addition to the Network Control Center..	2,200	---	---	
			JET PROPULSION LABORATORY	12,200	8,900	12,400	
SSA	7	255	Construction of Engineering Support Building..	---	---	9,800	CF 5-1
SSA	7	255	Modification of Uninterruptible Power System in Space Flight Operations Facility	---	---	2,600	CF 5-8
SSA	7	255	Construction of Microdevices Laboratory	---	8,900	---	
SSA	7	255	Construetion of Earth and Space Science Laboratory..	12,200	---	---	
			AMES RESEARCH CENTER	11,500	8,200	9,400	
AST	4	254	Construction of Human Performance Research Laboratory..	---	---	9,400	CF 6-1
AST	5	402	Construction of Numerical Aerodynamic Simulation Facility..	11,500	8,200	---	
			DRYDEN FLIGHT RESEARCH FACILITY	---	---	17,500	
AST	5	402	Construetion of Integrated Test Facility	---	---	17,500	CF 7-1

Cognizant Office	Budget Activity	Subfunction Code	Location and Project	FY 1985	FY 1986	FY 1987	Page No.
				(Thousands of Dollars)			
			LANGLEY RESEARCH CENTER	13,800	4,900	11,700	
AST	5	402	Modifications to &Foot High Temperature Tunnel..	13,800	---	9,700	CF 8-1
AST	5	402	Construction of Addition for Non-Destructive Evaluation Research Laboratory	---	---	2,000	CF 8-8
AST	5	402	Modifications to 16-Foot Transonic Tunnel for Improved Productivity and Research Capability	---	4,900	---	
			VARIOUS LOCATIONS	13,800	17,400	22,000	
ST&DS	7	255	Construction of the Second Tracking and Data Relay Satellite System Ground Terminal Facility in New Mexico	---	---	22,000	CF 9-1
ST&DS	7	255	Modification of 64-Meter Antenna DSS-14, Goldstone California (JPL)	---	8,509	---	
ST&DS	7	255	Modification of 64-Meter Antenna DSS-43, Canberra, Australia (JPL)	---	8,900	---	
ST&DS	7	255	Construction of 34-Meter Antenna, Madrid, Spain (JPL)	6,000	---	---	
ST&DS	7	255	Modifications of 64-Meter Antenna, DSS-63, Madrid, Spain (JPL).	7,809	---	---	
MGMT	7	255	Repair of Facilities at Various Locations, ~~Not~~ in Excess of $750,000 Per Project	18,000	22,000	24,000	CF 10-1
MGMT	7	255	Rehabilitation and Modification of Facilities at Various Locations, Not in Excess of $750,000 Per Project..	22,000	26,000	30,000	CF 11-1
MGMT	7	255	Minor Construction of New Facilities and Additions to Existing Facilities at Various Locations, Not in Excess of $500,000 Per Project	5,000	6,000	7,000	CF 12-1
MGMT	7	255	Facility Planning and Design.	12,000	11,000	14,000	CF 13-1
			TOTAL	157,600	139,300	181,300	

LOCATION OF MAJOR AND COMPONENT INSTALLATIONS



RECORDED VALUE OF CAPITAL TYPE PROPERTY
IN-HOUSE AND CONTRACTOR-HELD
AS OF SEPTEMBER 30, 1985
(DOLLARS IN THOUSANDS)

	REAL PROPERTY							
REPORTING INSTALLATION	LAND	BUILDING	OTHER STRUCTURES AND FACILITIES	LEASEHOLD IMPROVEMENTS	TOTAL	EQUIPMENT	FIXED ASSETS IN PROGRESS	GRAND TOTAL
AMES RESEARCH CENTER	2929	338495	25856	0	361280	355441	132130	855451
ARC MOFFETT FIELD, CA	2928	319761	11992	0	334681	241135	123093	104909
DRYDEN FLIGHT FACILITY EDWARDS, CA	0	18038	13518	0	31556	83915	9657	125158
VARIOUS LOCATIONS (a)	1	696	346	0	1043	24361	-20	25384
GODDARD SPACE FLIGHT CENTER	2840	153875	111884	0	268599	515074	31892	821565
GSFC - GREENBELT, MD	1361	103990	19517	0	124868	248239	28994	402101
TRACKING STATIONS NETWORK	5	14114	30601	0	44180	165285	2513	212578
WFF - WALLOPS ISLAND, VA	1474	35666	61753	0	98893	60454	6385	165132
VARIOUS LOCATIONS (a)	0	45	13	0	58	41096	0	41154
JET PROPULSION LABORATORY	1188	106548	84855	1893	194484	300364	25242	520090
JVL - PASADENA, CA	1188	93872	15548	1891	112499	221123	25242	365464
DEEP SPACE NETWORK	0	12676	69301	2	81985	12641	0	154626
JOHNSON SPACE CENTER	10889	213125	69208	0	293822	525849	8486	828157
JSC - HOUSTON, TX	1319	116405	42129	0	225853	410205	6143	642801
WHITE SANDS TEST FACILITY LOS CRUCES, NM		9102	21508		31210	18155	0	19365
VARIOUS LOCATIONS (a)	3570	27618	5571	0	36759	97489	1143	135991
KENNEDY SPACE CENTER	71345	432633	412546	0	976524	605005	95994	1677523
KSC - CAPE CANAVERAL, FL	11345	432633	412546		976524	166035	95994	1238553
WESTERN TEST RANGE, LOMPAC, CA					0	104853	0	104853
VARIOUS LOCATIONS (a)	0	0	0	0	0	334111	0	334117
LANGELY RESEARCH CENTER	162	156937	332159	0	489258	222046	53946	765250
LARC - HAMPTON, VA	162	156931	332108		489201	206987	53946	750140
VARIOUS LOCATIONS (a)	0	0	51	0	51	15059	0	15110
LEWIS RESEARCH CENTER	2621	231269	81929	136	315955	182380	25479	523814
LERC - CLEUELAYO, OH	316	154862	62861	136	218181	158114	25419	402374
PLUMBROOK SANDUSKY, OH	2305	16401	19062		91114	6213	0	104047
VARIOUS LOCATIONS (a)	0	0	0	0	0	17393	0	17393
MARSHALL SPACE FLIGHT CENTER	7148	253259	145775	0	406201	430488	0	836689
MSFC - HUNTSVILLE, AL	0	129131	66016	0	195153	271900	0	461053
MICHOUD ASSEMBLY FACILITY, AL	7095	114140	66343	0	181578	55214	0	242792
SLIDELL COMPUTER COMPLEX, AL	69	5133	2112	0	1914	6811	0	14785
VARIOUS LOCATIONS (a)	0	4849	10707	0	15556	96503	0	112019
NATIONAL SPACE TECH LABS	18061	80566	193011	0	291698	33356	0	325054
NSTL - NSTL STATION, MS	18061	80566	193011	0	291698	33295	0	324993
VARIOUS LOCATIONS (a)	0	0	0	0	0	61	0	61
NASA HEADQUARTERS	0	0	0	0	0	31144	0	31144
NASA - HQS, WASH, D C	0	0	0	0	0	16295	0	16295
VARIOUS LOCATIONS (a)	0	0	0	0	0	14849	0	14849
AGENCY TOTAL	117199	1967307	1511286	2029	3603821	3201147	319169	1184131

JUSTIFICATION
BY LOCATION

JOHNSON
SPACE CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

LYNDON B JOHNSON SPACE CENTER

Office of Space Flight:	Amount	Page No.
Construction of Central Computing Facility.....	9,000,000	CF 1-

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF CENTRAL COMPUTING FACILITY

LOCATION PLAN

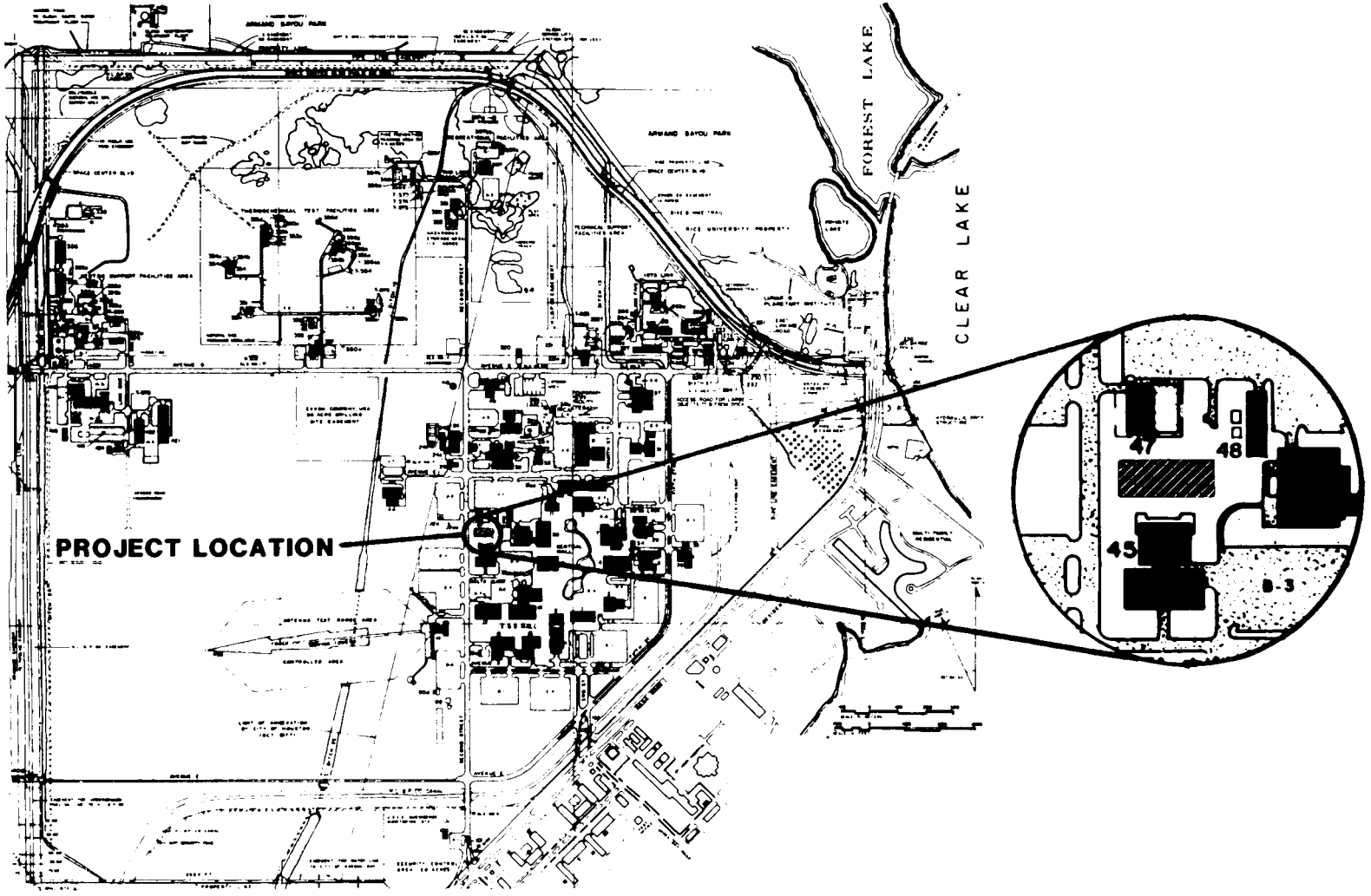


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Central Computing Facility

INSTALLATION: Lyndon B. Johnson Space Center

FY 1987 CoF Estimate: $9,000,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	740,000	---	740,000
Capitalized investment	N/A	---	---
Total	740,000	---	740,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of a 66,500-square foot facility to meet the immediate data processing requirements of the Johnson Space Center (JSC). All existing computer-related areas are fully utilized or over-extended. This new facility will provide the space to accommodate planned additional large-scale computer systems and support equipment to consolidate the center's administrative ADP functions; provide space for Space Shuttle engineering and development computers; and support the initial automated management information systems for the Space Station Program.

PROJECT JUSTIFICATION:

This project is required to house data processing systems growth resulting from requirements for productivity increases, project support expansion, and a need to consolidate scattered operations. Space Shuttle operations activities have consumed all available computer floor space, and the planned growth in computational capability to support future space flight operations can not be accommodated. Space Shuttle operations growth to support increased flight rates and productivity gains requires additional system dedication and isolation from other computing systems and functions. This requires that the multipurpose administrative, functional and engineering computing systems be relocated to other computer space. The Space Station program will also generate new automated information management and data systems requirements which will cause significant growth in research and engineering computational capacity. Space must be provided to accommodate this growth. This central computing facility will also provide a higher level of computer security than can be economically achieved in the existing computer space and locations.

The existing center computer floor space will continue to be utilized to consolidate Space Shuttle operations and dedicated research and engineering systems. However, the new computer building will permit relocation of functions such as the Space Shuttle software production system and will provide the physical separation and protection for critical Space Shuttle software processing systems. This will relieve serious overcrowding in existing computer space and result in a much improved and more efficient layouts.

The new facility will also provide space for expansion of JSC automated administrative functions and will enhance centerwide productivity through computational systems growth that cannot be accomplished in existing space. Additional computer space is also essential for initial efforts in support of the Space Station's automated information management and data systems. The new computing facility will provide for the above near term requirements for computer floor space.

IMPACT OF DELAY:

Delay of this project will mean that space and supporting utilities will not be available for new computer equipment that JSC will be receiving in 1988. Without suitable housing, this equipment will not be able to support critical Shuttle operations functions and will not be available for initial Space Station computational and technical support. It is most essential that this additional computer space be provided at this time.

PROJECT DESCRIPTION:

This project provides for the construction of a three-story steel framed building of approximately 66,500 square feet of floor space on the east side of Second Street, north of Building 45 (Figure 1). Site work will include the construction of a connecting tunnel to the JSC utility tunnel system, storm drainage, sanitary sewer, waterlines, communications, and a service drive with parking. The building (Figure 2) will include three access zones for computer security, approximately 47,000 square feet of raised computer floor area, and office space. Also included is a tape library, operations support areas, an elevator with a load capacity of 10,000 pounds, and a loading dock. Electrical power, cooling, lighting, communications, fire detection and alarm and suppression equipment to support large scale computer systems will be provided.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	9,000,000
Site work, utilities, and paving	LS	---	---	560,000
Structural	SF	66,500	42.26	2,810,000
Architectural	SF	66,500	30.23	2,010,000
Electrical	SF	66,500	20.15	1,340,000
Mechanical	SF	66,500	34.28	2,280,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				9,000,000

LIST OF RELATED GRAPHICS:

Figure 1 - Project Location
Figure 2 - Central Computing Facility

OTHER EQUIPMENT SUMMARY:

Computers and other electronic data processing equipment of approximately $32,700,000 will be provided by R&D funds.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project. Present planning of computer system growth indicate that a comparably-sized building addition may be required in the future.

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF CENTRAL COMPUTING FACILITY

CENTRAL COMPUTING FACILITY

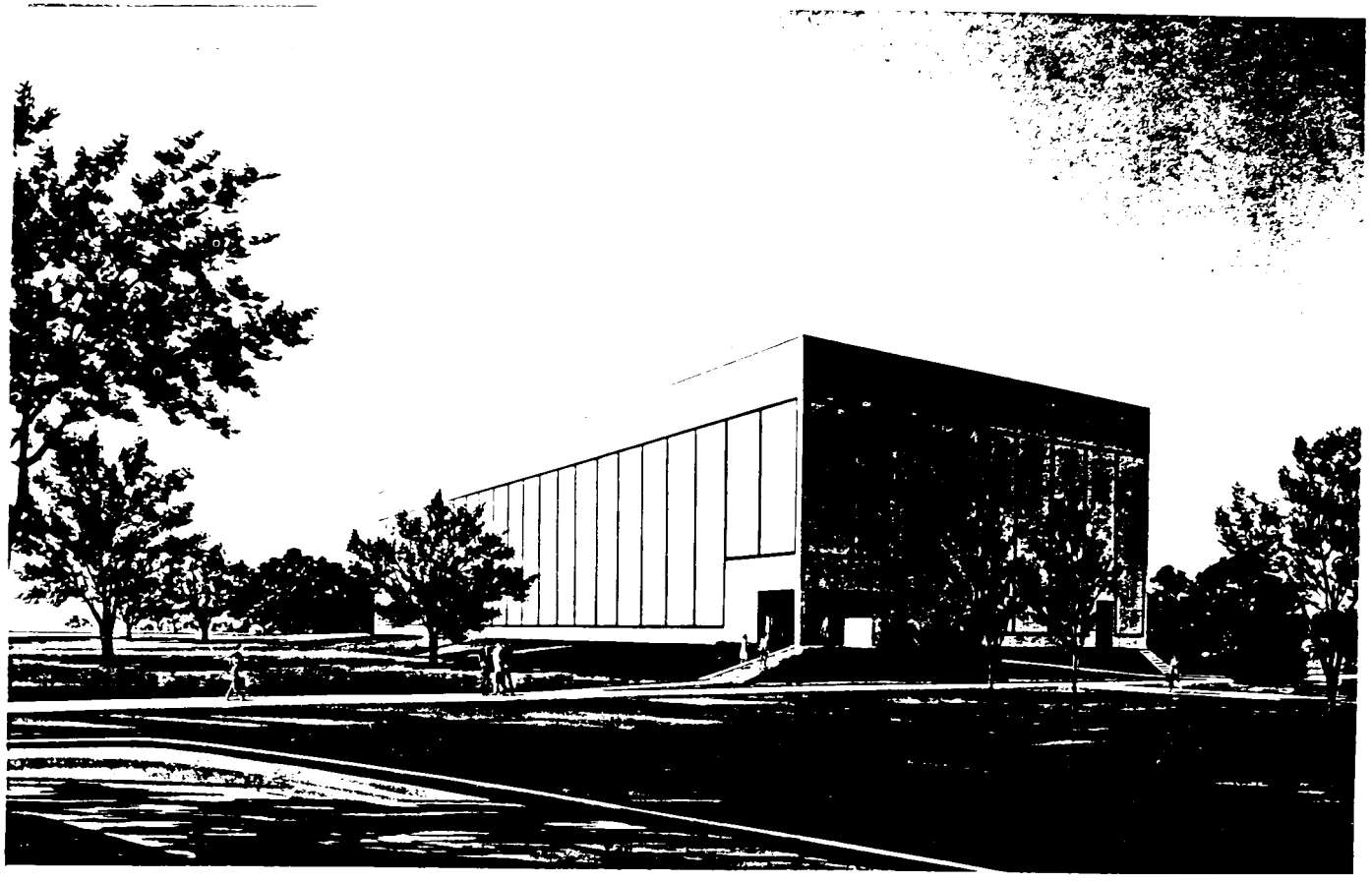


FIGURE 2

SPACE
STATION
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

SPACE STATION FACILITIES

Office of Space Station:	Amount	Page No.
Construction of Addition to the Systems Integration and Mockup Laboratory, Johnson Space Center	5,000,000	CF 2-1
Construction of Power Systems Facility, Lewis Research Center	5,800,000	CF 2-8
Modifications to Test Stand 300 for Space Station Hydrogen/Oxygen Propulsion Systems Development, Marshall Space Flight Center	2,100,000	CF 2-15
Total	12,900,000	

JOHNSON SPACE CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION TO THE SYSTEMS INTEGRATION AND MOCKUP LABORATORY

LOCATION PLAN

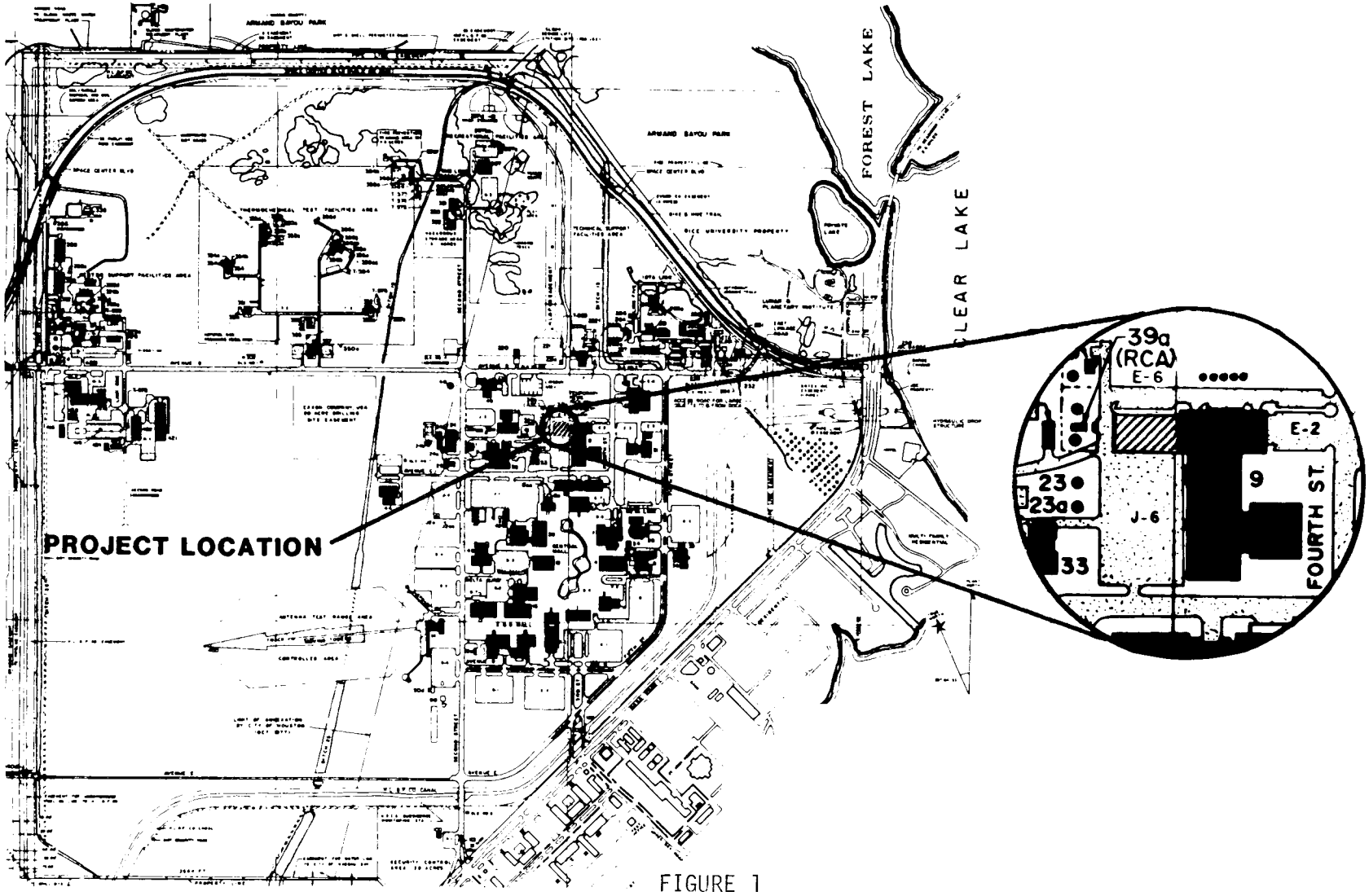


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Addition to the Systems Integration and Mockup Laboratory

INSTALLATION: Lyndon B. Johnson Space Center

FY 1987 CoF Estimate: $5,000,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	440,000	---	440,000
Capitalized investment	N/A	5,220,000	5,220,000
Total	440,000	5,220,000	5,660,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of an addition to the Systems Integration and Mockup Laboratory, Building 9, to house the Space Station large scale mockups and trainers. Approximately 20,600 square feet of high bay and 6,000 square feet of one-story support area will be added. It is essential that this space be provided now *so* that critical system integration and development can be accomplished to support the'initial operational capability (IOC) of the Space Station.

PROJECT JUSTIFICATION:

The Space Station hardware will be constructed in space without it ever having been completely assembled on Earth. This unique approach requires that extensive systems engineering and integration capabilities be provided on the ground. To provide this capability, an extensive system of mockups and trainers is required. Presently, facilities at JSC and at other NASA centers are being used for the early concept development phases of the program, but it is essential that eventually this work be brought together in a central location so that proper detailed integration can be achieved. As the program progresses, higher fidelity mockups and trainers will be needed to develop and evaluate hardware and procedures. Integration of the Space Station, Mobile Remote Manipulator System and the Shuttle is another function that must be performed using the mockups and trainers that will be housed in the facility.

Present facilities at JSC cannot accommodate the mockups, trainers and associated activities and personnel required for the Space Station. An addition to the Systems Integration and Mockup Laboratory of Building 9 is the most cost-effective means of providing the required high bay floor space and associated support areas. Extending the high bay allows the existing overhead cranes, high bay doors, and air-bearing floor to support the new requirements. The expanded facility will provide space for the Space Station Man-System Test Bed, (MSTB), an integrated Mobile Remote Manipulator Development Facility (MRMDF), associated mockups and test activities, and operations for development and verification of station assembly and resupply techniques. The MSTB will be used for interior architectural definition, habitability verification, maintainability evaluations, operations development, and fit checks. This will provide engineering evaluation of the Space Station mobile remote manipulator arm and control system. The MSTB and MRMDF will support the concept development, engineering definition operation support, and station growth analysis. This facility needs to be operational at the end of calendar year 1987 to support Space Station mockup and manipulator system delivery and engineering schedules.

IMPACT OF DELAY:

Delay of the project will result in inadequate space for the Man-Systems Test Bed, the Mobile Remote Manipulator Development Facility and associated mockup and test articles required by the Space Station development program. This will seriously affect the ability of the Space Station program to meet its initial operational capability (IOC).

PROJECT DESCRIPTION:

This project provides for the construction of a 26,600-square foot addition to the Systems Integration and Mockup Laboratory of Building 9 (Figure 1). Site development includes the relocation of underground utilities, construction of a concrete ramp on the west end of the addition, electrical power, and parking. The high bay addition of 20,600-square foot will be a steelframe structure with precast, exposed aggregate facing panels (Figure 2). Also included is a one-story steelframe addition of 6,000 square feet that will provide space for technical support, mechanical and electrical equipment, restrooms, and storage. Additional air-conditioning and heating, fire detection and suppression, electrical power and lighting will also be provided. Modifications to Building 9 include relocating the large access door to the west end of the addition and extending the rails for an existing 20-ton capacity traveling crane to be used in the high bay addition.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	5,000,000
Site Preparation:	---	---	---	500,000
Utilities	LS	---	---	(50,000)
Concrete ramps and parking	LS	---	---	(300,000)
Electrical power	LS	---	---	(150,000)
High Bay Addition	---	---	---	3,400,000
Structural	LS	---	---	(2,420,000)
Mechanical	LS		---	(620,000)
Electrical	LS	---	---	(360,000)
Technical Support Addition	---	---	---	*goo* ,000
Architectural and structural	LS	---	---	(550,000)
Mechanical	LS	---	---	(230,000)
Electrical	LS	---	---	(120,000)
Modifications to Building 9	---	---	---	200,000
Architectural and structural	LS	---	---	(100,000)
Mechanical	LS	---	---	(90 ,000)
Electrical	LS	---	---	(10,000)

Equipment.....	---	---	---	---
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				5,000,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Exterior Perspective

OTHER EQUIPMENT SUMMARY:

Non-collateral equipment costing approximately $6,000,000 will be required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

CoF resources may be required in the future to provide additional space to support related systems engineering and integration activities.

JOHNSON SPACE CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION TO THE SYSTEMS INTEGRATION AND MOCKUP LABORATORY

EXTERIOR PERSPECTIVE

FIGURE 2

LEWIS RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF POWER SYSTEMS FACILITY

LOCATION PLAN

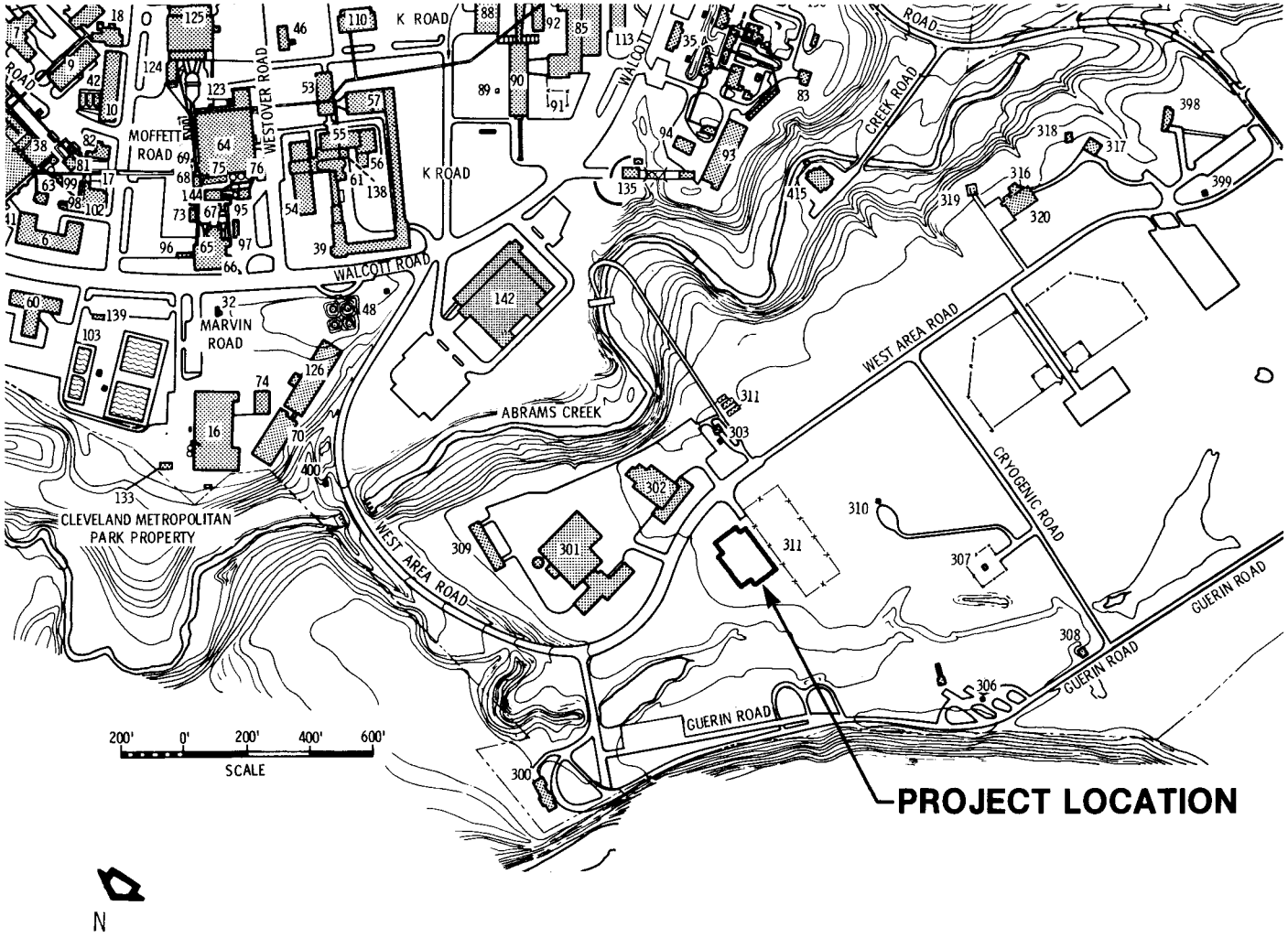


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAH 1987 ESTIMATES

PROJECT TITLE: Construction of Power Systems Facility

INSTALLATION: Lewis Research Center

FY 1987 CoF Estimate: $5,800,000

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	460,000	---	460,000
Capitalized investment.....	N/A	---	---
Total.....	460,000	---	460,000

SUMMARY PURPOSE AND SCOPE:

The Power Systems Facility (PSF) will provide the capability for development, testing and evaluation of prototype power systems hardware for the Space Station program. The facility will be used to test systems in support of the initial operational capability (IOC) and follow-on operational phases of the Space Station, simulate anomalies during flight, and support testing needs for future refinements. The PSF will have a total area of approximately 31,000 square feet and will include a high bay test area with Class 100,000 Clean Room

capability, a loading-unloading-workshop area, laboratory rooms and support areas, and will be capable of testing both photovoltaic and solar dynamic power systems. Existing facilities were evaluated and determined to be inadequate for meeting the power systems hardware development and testing requirements.

PROJECT JUSTIFICATION:

The power system for the Space Station, which may be photovoltaic or solar dynamic or a hybrid of both, will be the largest and most complex ever launched into space. Because of its size and complexity, and also because it is essential to develop and thoroughly test such a power system to satisfy the stringent requirements for long duration operations in space, a Power Systems Facility is needed to provide the space capability and cleanliness required for critical development and performance verification. Testing will be done on engineering and initial flight models. Interactions among the power generation, storage, management, and distribution components, and transient behavior of the full system during normal and abnormal conditions will also be determined in the facility using full-sized system configurations.

The PSF will have the capability to test both the photovoltaic and solar dynamic systems. An initial flight photovoltaic solar array will be deployed in the high-bay area, illuminated with lights simulating the sun, and tested with the regenerative fuel cell or battery storage subsystem. Solar dynamic systems will be tested with electrical heat simulating solar heat and tested together with the power management and distribution system. Assembly/deployment tests, optical tests, and vibration tests of concentrating mirrors as large as 60 feet in diameter will be conducted in the clean high-bay area.

The building site (Figure 1) has been selected for its close proximity to the existing solar array field in recognition of the importance of using line lengths representative of the Space Station electrical power distribution system. Electrical transient interactions are very sensitive to line lengths and component separation as well as the detailed characteristics of the power source. While some studies will be done using the solar simulator others will require use of the outside solar array powered by the sun.

Power system testing in the PSF will support the development phase for the initial operational capability (IOC) of the Space Station, and the investigation of problems encountered during station operation, aid in the integration of payloads with special power needs, and support the development and verification of power system modifications and additions as the Space Station matures.

The PSF will replace inadequate trailers that are now used as the Space Station Power Test Bed for advanced development testing. Also, the present accommodations do not provide adequate assembly/repair shop areas, regenerative fuel cell test area, room for discrete and customized loads, high-bay areas for testing of flight-type arrays and for disassembly and tests of concentrators for solar dynamic power systems.

IMPACT OF DELAY:

This project is needed now to support the development design of the Space Station in time for the initial operational capability (IOC). Delay would result in the power system research and development being performed in undersized and inadequate facilities that would significantly compromise the development of this critical element of the Space Station.

PROJECT DESCRIPTION:

This project will provide a new PSF, with a floor area of approximately 31,000 square feet, located in the LeRC West Area (Figure 2) near the existing solar array field. The PSF will consist of a 10,300-square foot high bay test area approximately 45 feet high with Class 100,000 Clean Room capability (Figure 3). Adjacent to this test area will be a 2,300-square foot loading-unloading-workshop area. The test area and the loading-unloading-workshop area will each be provided with 10-ton overhead cranes to facilitate test build-up and equipment handling. Supporting laboratory areas, consisting of 6,500 square feet, will include a battery room, solar dynamics laboratory and simulator, electrical load, control, and computer rooms, controls laboratory and software support center, power processing laboratory, terminal room, fuel cells and simulator room, and a vacuum tank area. The remaining 11,900 square feet will be general support area. Standard utility services of water, steam, service air, electrical power, communication, and safety systems will also be provided.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	5,800,000
Site development/utilities	LS	---	---	362,000
Building	SF	31,000	169.77	5,263,000
Special features (cranes)	LS	---	---	175,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				5,800,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - First Floor Plan

OTHER EQUIPMENT SUMMARY:

R&D funded noncollateral equipment costing approximately $2,700,000 will be provided. Included are items such as computers, data acquisition systems, instrumentation, batteries, controllers and related test equipment.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project.

LEWIS RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF POWER SYSTEMS FACILITY

SITE PLAN

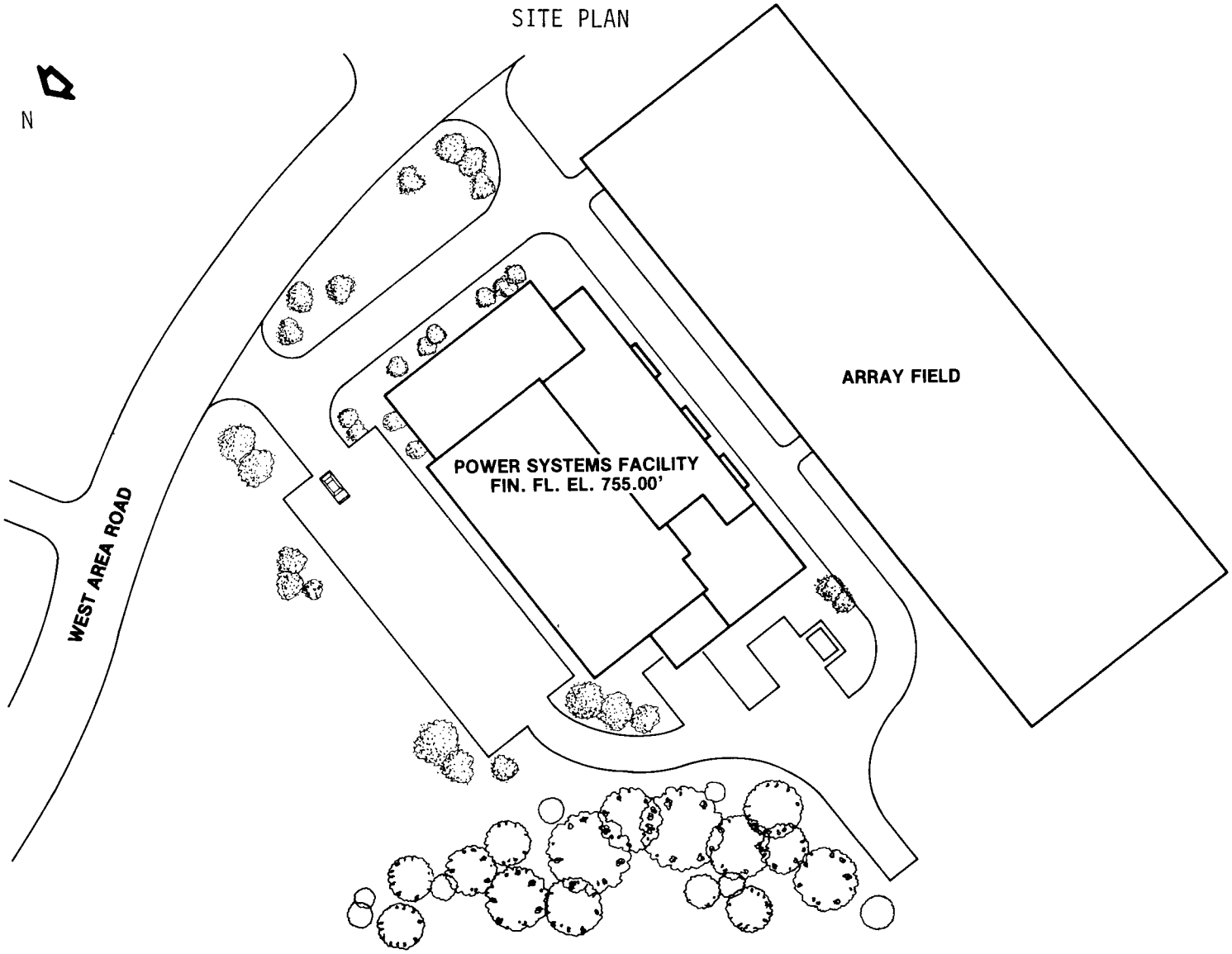


FIGURE 2

LEWIS RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF POWER SYSTEMS FACILITY

FIRST FLOOR PLAN

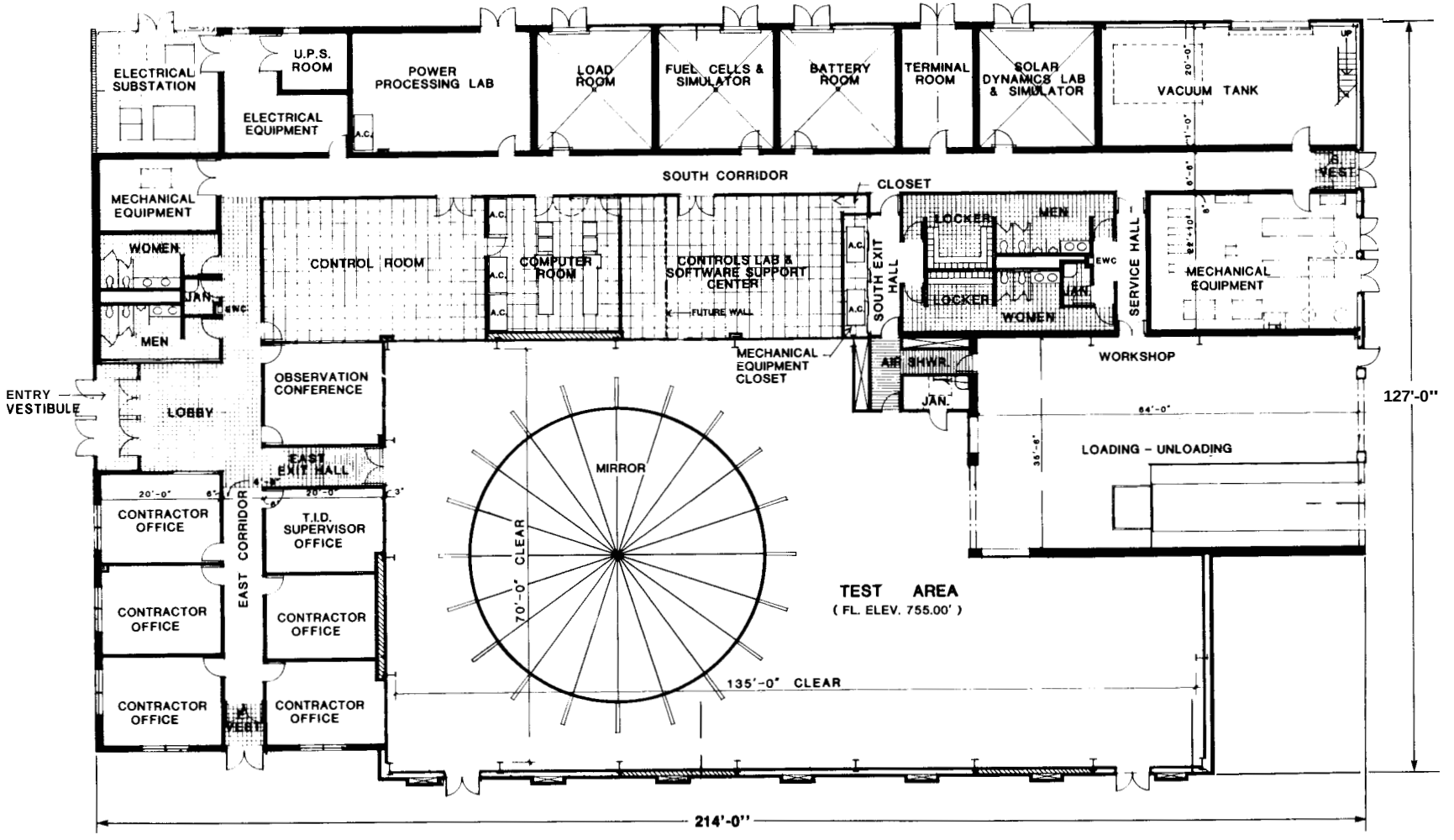


FIGURE 3

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
MODIFICATIONS TO TEST STAND 300 FOR SPACE STATION HYDROGEN/OXYGEN
PROPULSION SYSTEMS DEVELOPMENT

LOCATION PLAN

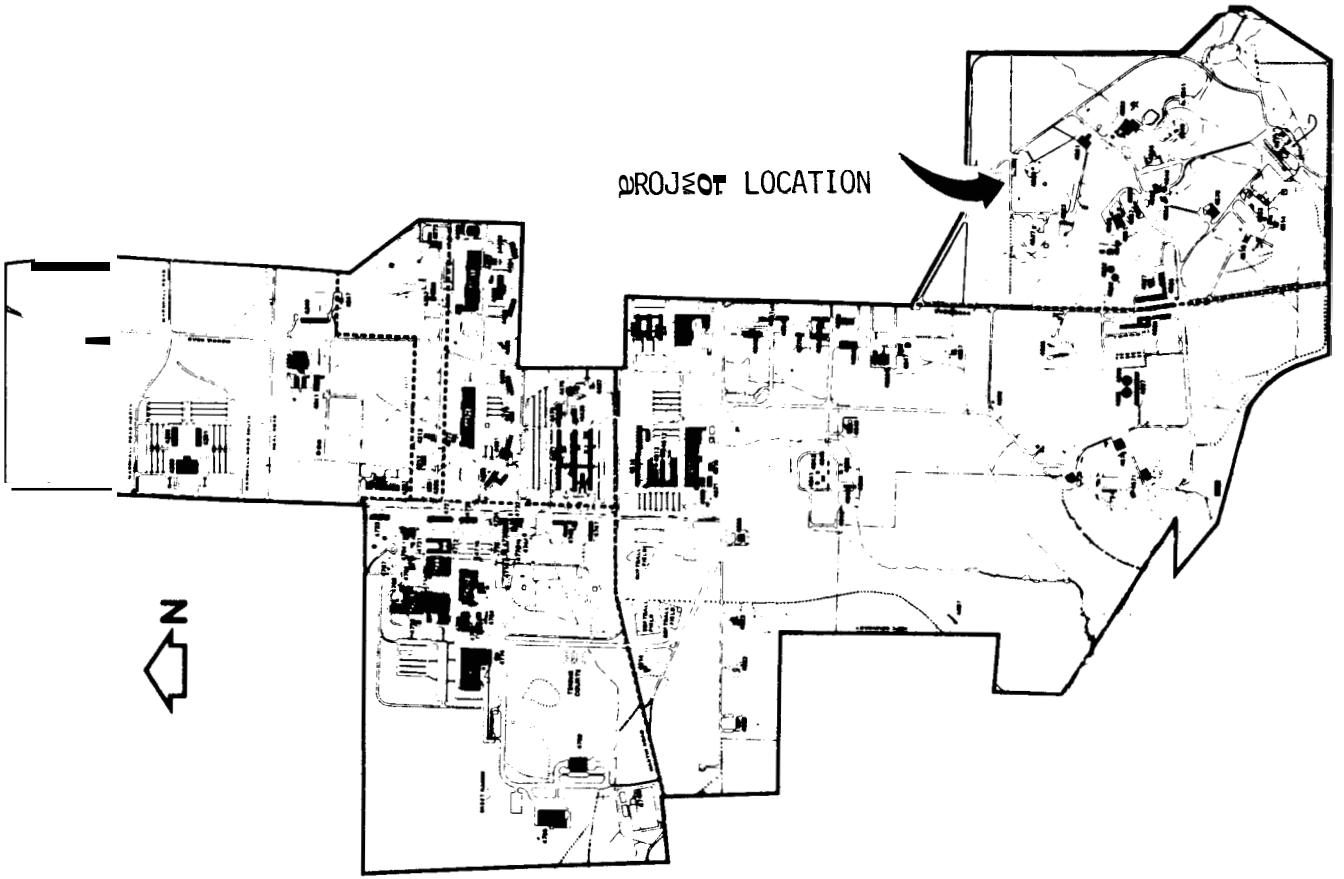


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

1

PROJECT TITLE: Modifications to Test Stand 300 for Space Station Hydrogen/Oxygen Propulsion Systems Development

INSTALLATION: George C. Marshall Space Flight Center

FY 1987 CoF Estimate: $2,100,000

LOCATION OF PROJECT: Marshall Space Flight Center, Madison County, Alabama

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	192,000	---	192,000
Capitalized investment	N/A	1,200,000	1,200,000
Total	192,000	1,200,000	1,392,000

SUMMARY PURPOSE AND SCOPE:

This project modifies Test Stand 300 at Marshall Space Flight Center (MSFC) for testing of the integrated propulsion systems of relatively low thrust in the range of a few pounds to a few hundred pounds at simulated altitude and thermal conditions. The existing propulsion system technology employs hydrazine fuels. The goal of the advanced development program is to provide technology which will employ fuels of higher specific energy, such as LOX/H_2, with minimal environmental contamination. To develop and test these oxygen/hydrogen propulsion systems, a test stand capable of providing orbital vacuum simulation, handling of cryogens, and

allowing propellant flow and start testing is required. Test Stand 300, with the modifications provided by this project, can best provide these capabilities.

PROJECT JUSTIFICATION:

This development program has as its aim, bringing the high performance oxygen-hydrogen propellant concept to a level of maturity commensurate with current systems. The use of propulsion systems employing high efficiency oxygen and hydrogen fuels on the Space Station will lead to a significant reduction in life cycle costs because of the reduced amount of propellant that will have to be transported from earth. These oxygen/hydrogen propellant systems will also reduce the environmental contamination due to fuel residue resulting from the present systems. Environmental contaminations would reduce the utility of the Space Station for scientific applications which require the cleanest possible local viewing conditions for optical instruments.

MSFC is the lead center for Space Station propulsion activities with responsibility for full systems development and testing. These activities include the development of systems hardware and operational techniques for the use of oxygen and hydrogen fluid systems. Systems components such as tanks, thrusters, lines, and controls will be developed at other centers or at contractor facilities. All of these prototype components must be tested as a complete system. In addition, the system testing must be operated in a relevant environment. Tests will include start transients, venting and fuel flow, thermal testing of distributed fuel systems, and insulation performance. Test Stand 300 will be modified to provide this capability for Space Station propulsion tests at simulated altitude and thermal conditions. To support high performance propulsion systems tests the 20-foot diameter space vacuum chamber will require additional vacuum pumping capability to sustain orbital altitude conditions with additional cryogenic cold walls, liquid hydrogen, oxygen and nitrogen storage capacity, expanded electrical power, instrumentation, controls and safety equipment. These modifications must be completed in 1988 to permit timely testing of prototype components, development hardware, and protoflight hardware for the Space Station.

IMPACT OF DELAY:

Delay of this project will prevent the timely development of an integrated propulsion system for the Space Station. This facility must be operational in 1988 to receive initial prototype component deliveries under the Space Station advanced development program. Time is needed to accumulate and analyze performance data prior to the launch of the first Space Station elements.

PROJECT DESCRIPTION:

This project will modify Test Stand 300, site 4530 (Figure 1) to include the addition of a 48-inch diffusion pump and isolation valve, a stainless steel low temperature cryogenically cooled thermal shroud in the 20-foot diameter space vacuum chamber and other related work (Figure 2). Work also includes relocation of an existing 35,000-gallon liquid hydrogen dewar and a 14,000 gallon liquid nitrogen dewar. It also includes vacuum jacketed piping, pumps, and related cryogenic transfer equipment for oxygen, hydrogen, and nitrogen. Electrical modification includes the installation of new data acquisition equipment, remote controls, instrumentation, electrical power and fireprotection systems. The project will also provide modifications for instrumentation systems in the test control and data recording centers.

PROJECT COST ESTIMATE:

The project cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	2,100,000
Mechanical	---	---	---	1,260,000
Diffusion pump and piping	LS	---	---	(210,000)
Cryo panels and piping	LS	---	---	(330,000)
Rehabilitate 20-foot diameter chamber	LS	---	---	(90,000)
Cryogenic tanks and equipment	LS	---	---	(630,000)
Electrical	---	---	---	780,000
Data acquisition system.	LS	---	---	(430,000)
Controls	LS	---	---	(50,000)
Instrumentation	LS	---	---	(110,000)
Electrical power equipment	LS	---	---	(190,000)
Architectural/Structural	LS	---	---	60,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				2,100,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan

OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
MODIFICATIONS TO TEST STAND 300 FOR SPACE STATION HYDROGEN/OXYGEN
PROPULSION SYSTEMS DEVELOPMENT

SITE PLAN

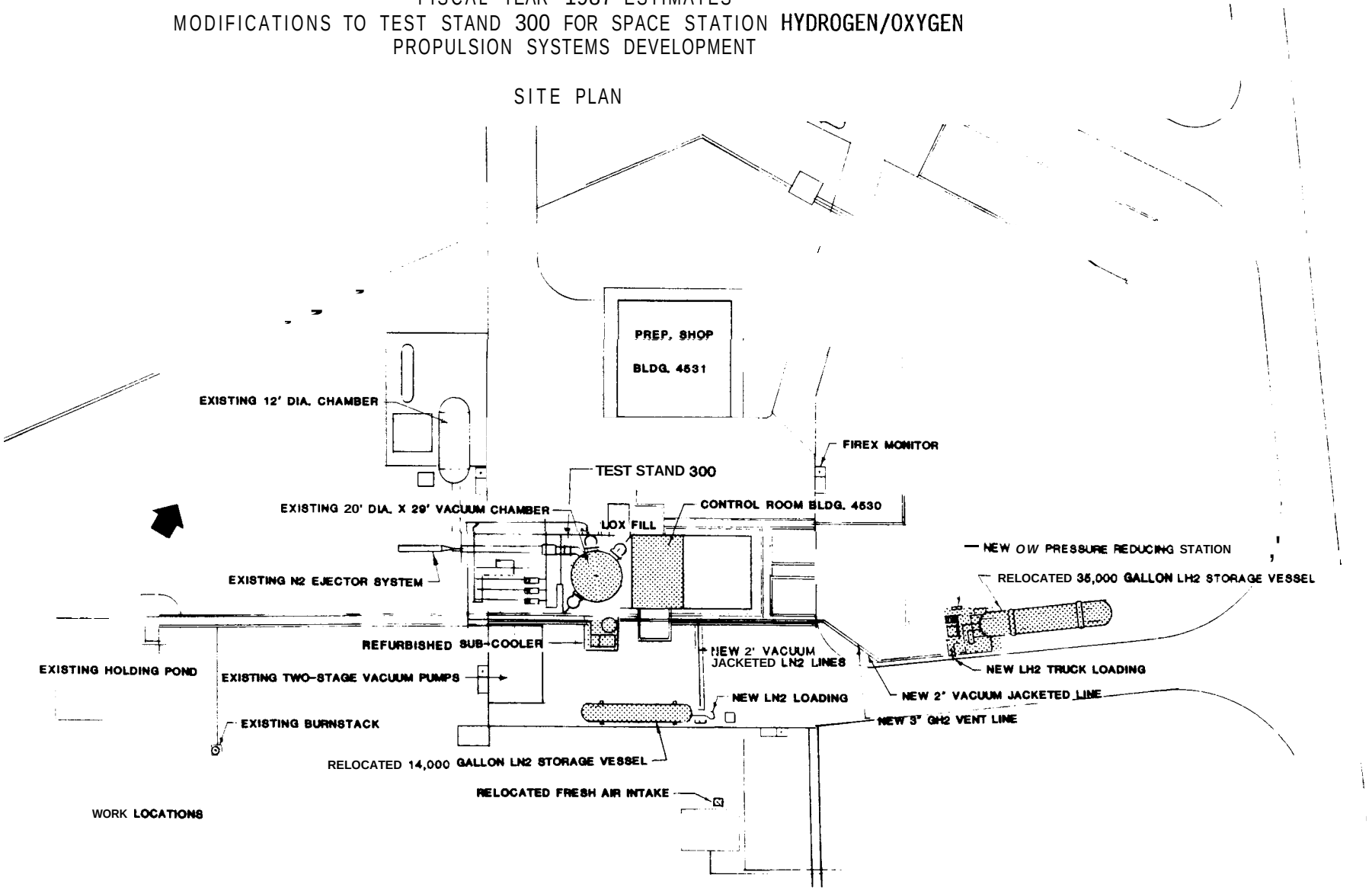


FIGURE 2

SPACE
FLIGHT
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

SPACE FLIGHT FACILITIES

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION TO ORBITER PROCESSING FACILITY ANNEX

LOCATION PLAN

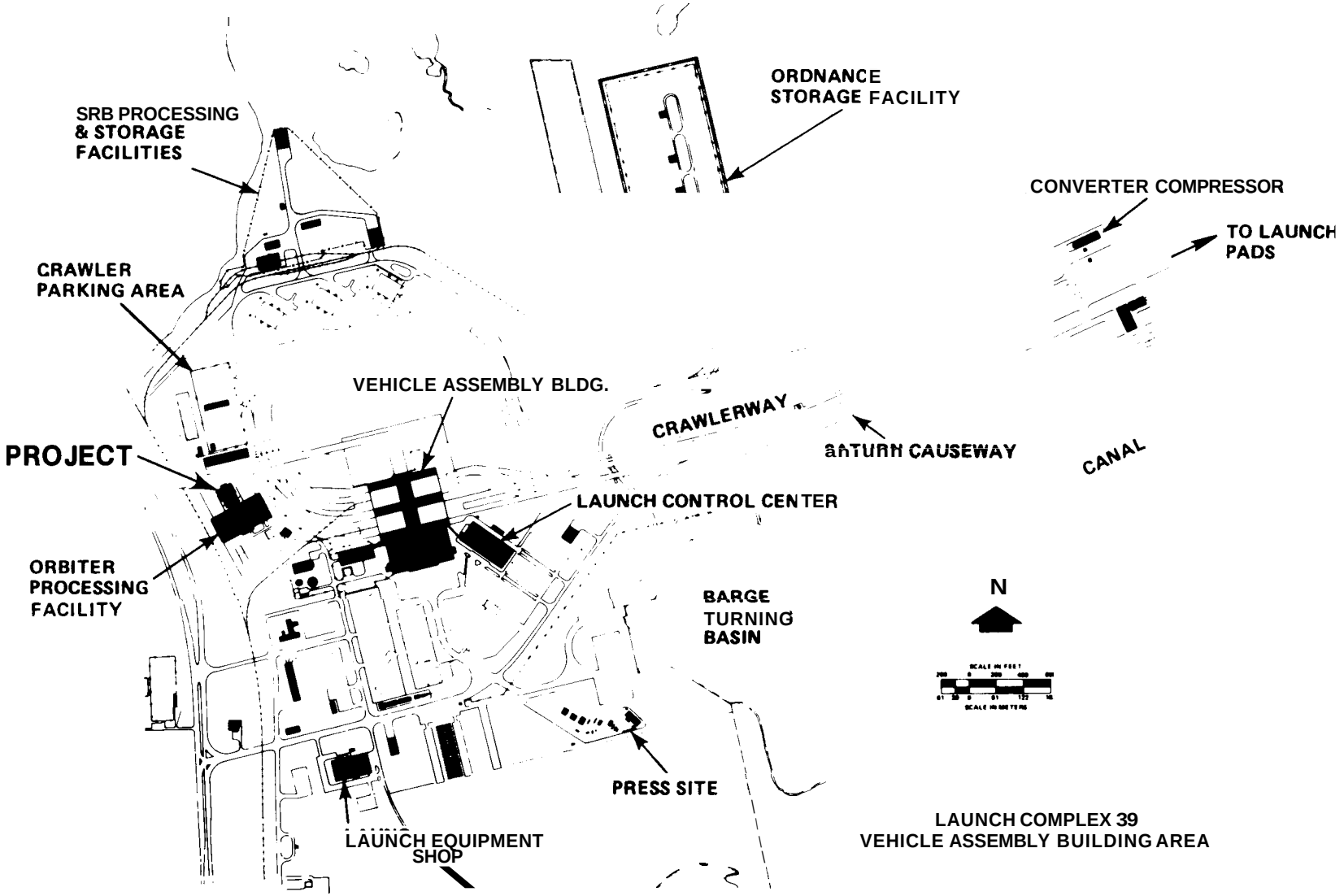


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Addition to Orbiter Processing Facility Annex

INSTALLATION: John F. Kennedy Space Center

FY 1987 CoF Estimate: $3,400,000

LOCATION OF PROJECT: John F. Kennedy Space Center, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	337,000	---	337,000
Capitalized investment	N/A	36,321,257	36,321,257
Total	337,000	36,321,257	36,658,257

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of a three-story addition to the annex of the Orbiter Processing Facility (OPF) for adequate support space for the operational processing of the Space Transportation System (STS) Orbiter. It consists of approximately 36,000 square feet with the first floor providing a central marshalling/locker area for technical and quality control personnel, and the second and third floors housing OPF support personnel. This project eliminates the existing trailers north and west of the annex, now used by personnel involved in Orbiter processing.

PROJECT JUSTIFICATION:

As the Space Shuttle continues into the operational era, around-the-clock processing will be taking place in both bays of the OPF. Early estimates of the nature and amount of work required to deservice and process an Orbiter between flights were underestimated. Almost four years of experience have clearly shown that Orbiter turnaround will continue to be a labor intensive, time-critical operation, requiring many technicians and quality control personnel.

The nearly 1,000 technicians and quality control personnel associated with operations in the OPF are currently housed in and operate from substandard temporary facilities. Since basic locker rooms, rest rooms, and eating facilities were not provided in the original facility, trailers and vans have been brought on site for lunch/vending areas, rest rooms, flight hardware and ground support equipment (GSE) storage, and offices. Portable latrine facilities are in use both northwest and west of the facility. Hallways are being used for storage and shop space; several small annex rooms have been turned into offices or engineering support space; and the outside areas adjacent to the OPF are of necessity, frequently used for additional shop and storage space when the weather permits. These crowded and undesirable working conditions cannot sustain the quality of performance and efficient processing needed for an operational orbiter fleet. This project eliminates the need for the existing trailer complex north of the Annex and the trailers and port-0-lets west of the OPF, eliminating a total of 36 trailers. This project also allows for the relocation of nonessential personnel from the hazardous environment of the existing high bays to more suitable accommodations,

IMPACT OF DELAY:

Deferral will result in continued inefficiencies due to use of the temporary, substandard and inadequate accommodations for the OPF personnel, equipment and flight hardware and deter the enhanced effectiveness needed to attain planned program flight rate objectives.

PROJECT DESCRIPTION:

This project provides for the construction of a three-story addition to the OPF Annex of approximately 36,000 square feet with an enclosed walkway between the addition and the OPF low bay. The air-conditioned building will be of steel frame and concrete masonry construction, providing space on the first floor for marshalling and locker areas, technicians, and quality control personnel. The second and third floors will be built in an open engineering space concept for housing OPF support personnel. Tie-ins to existing utilities, restrooms, and a lunch/vending area for personnel associated with Orbiter processing at the OPF will also be included.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report (PER).

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	3,400,000
Site development & utilities	SY	3,245	58.55	190,000
Temporary trailer relocations	EA	24	8,958.00	215,000
Building/structural	SF	36,000	77.86	2,803,000
Special features	LS	1	---	192,000
Equipment	---	---	---	---
Fallout Shelter (not feasible).	---	---	---	---
Total				3,400,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Perspective

OTHER EQUIPMENT SUMMARY:

Non-collateral equipment such as systems furniture and communications equipment will be funded from $800,000 of R&D resources.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION TO ORBITER PROCESSING FACILITY ANNEX

SITE PLAN

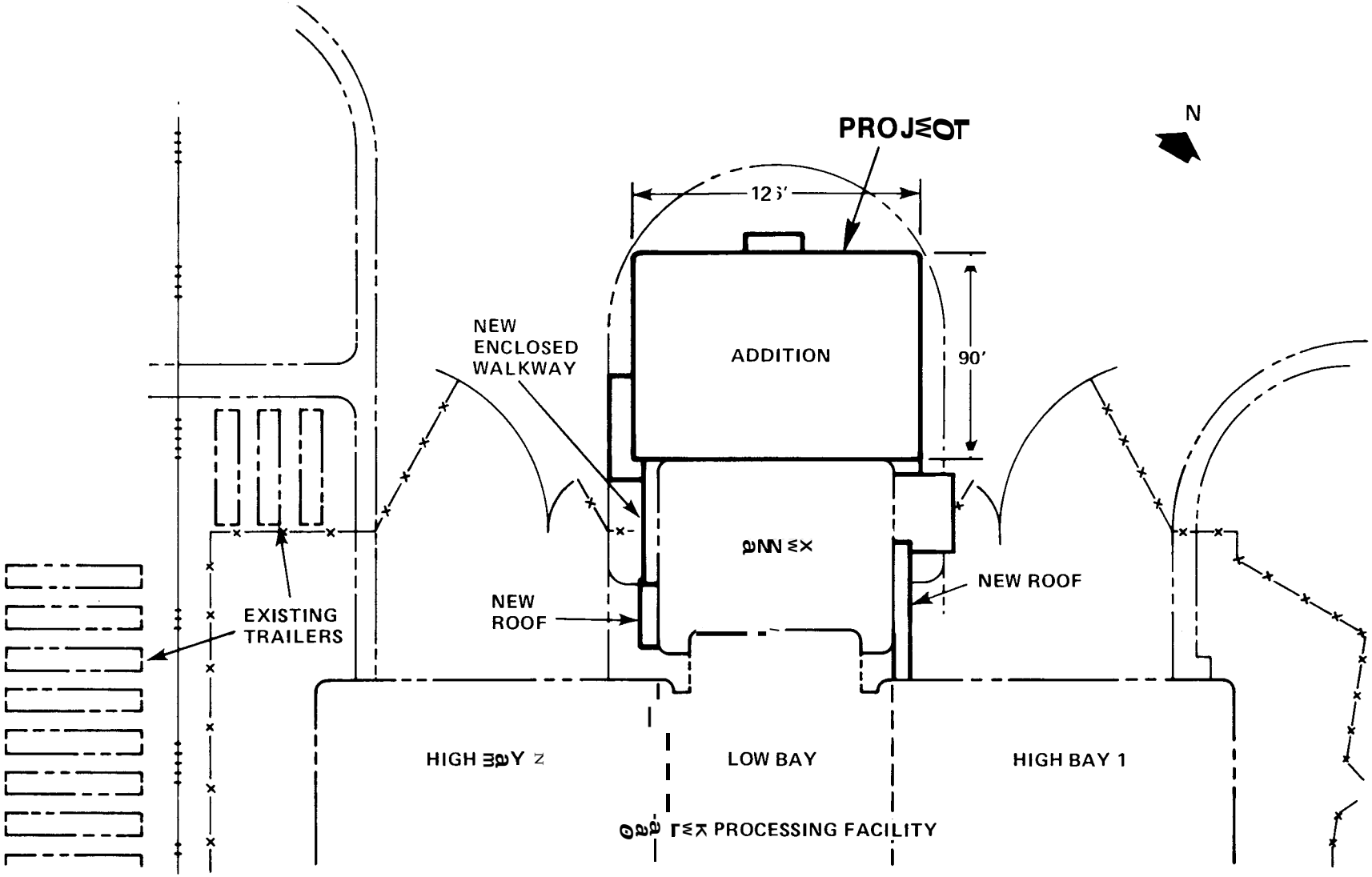


FIGURE 2

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION TO ORBITER PROCESSING FACILITY ANNEX
PERSPECTIVE

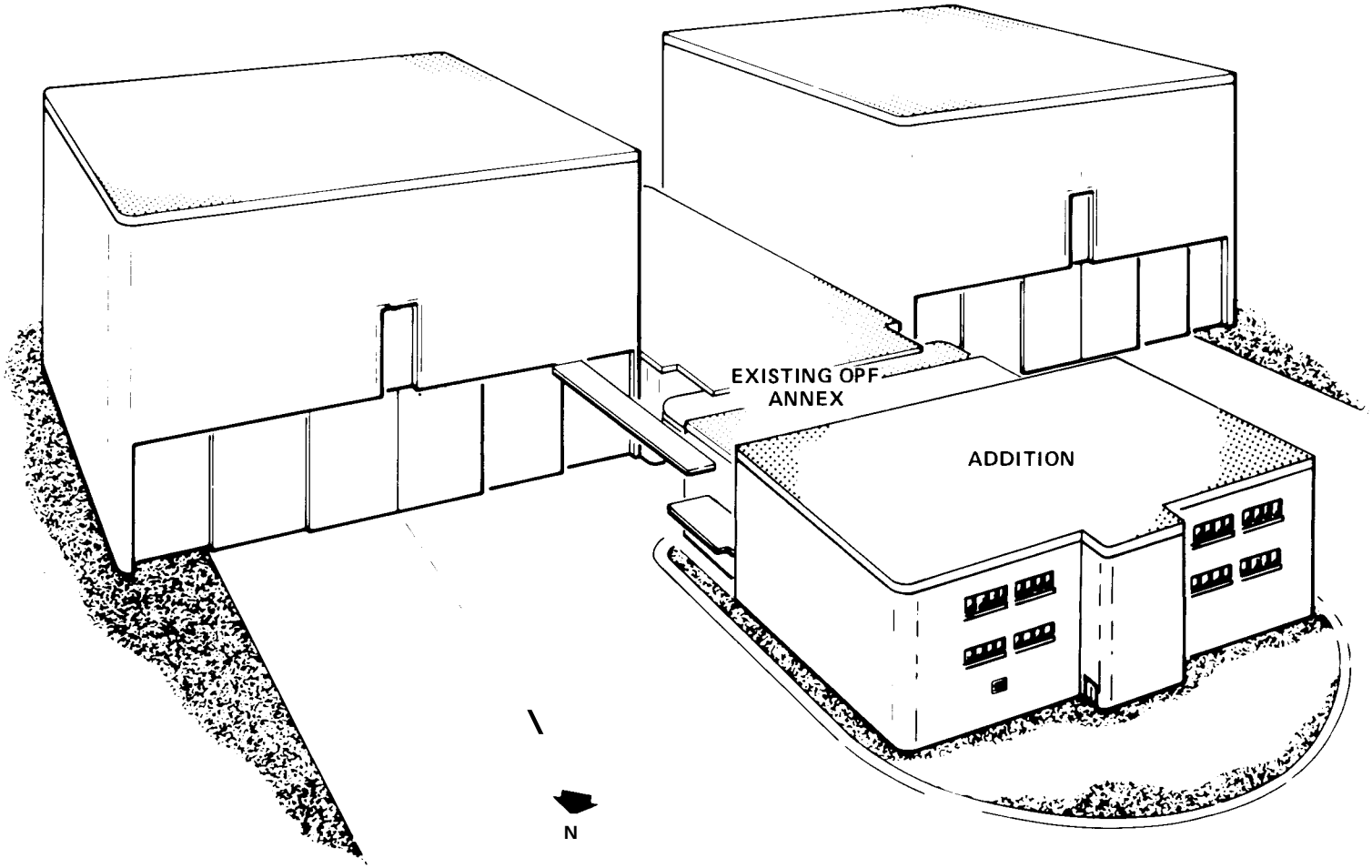


FIGURE 3

GODDARD
SPACE FLIGHT
CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

GODDARD SPACE FLIGHT CENTER

of Space Sc		
Construction of Spacecraft Systems Development and Integration Facility	8,000,000	CF 4-1

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF SPACECRAFT SYSTEMS DEVELOPMENT AND INTEGRATION FACILITY

LOCATION PLAN

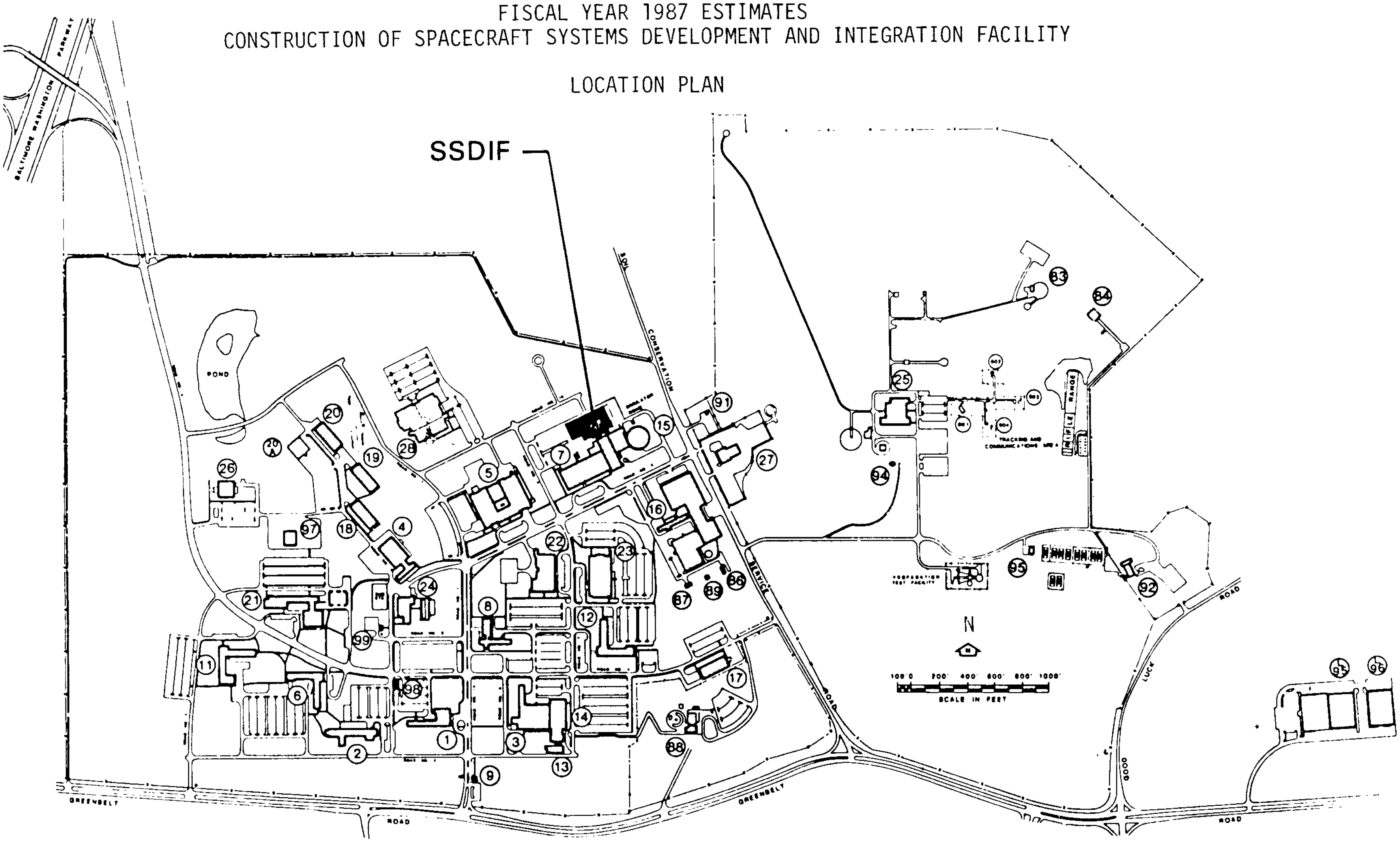


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Spacecraft Systems Development and Integration Facility

INSTALLATION: Goddard Space Flight Center

FY 1987 CoF Estimates: $8,000,000

LOCATION OF PROJECT: Greenbelt, Prince George's County, Maryland

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,100,000	---	1,100,000
Capitalized investment	N/A	---	---
Total	1,100,000	---	1,100,000

SUMMARY PURPOSE AND SCOPE:

This project provides the first increment of construction of an addition to the Building 7/10/15 complex to provide a Spacecraft Systems Development and Integration Facility. This facility will accommodate simultaneous multi-year development and integration, and/or major long term refurbishment of two spacecraft, each up to the size of a full shuttle payload, in a work space equipped with requisite stringent environmental controls. Present GSFC facilities are too small for full size shuttle payloads, and the high throughput pre-launch processing facilities at the Kennedy Space Center are not intended nor available for this longer term work. The second and final increment to complete the facility is planned for FY 1988.

PROJECT JUSTIFICATION:

With the Space Shuttle now operational, full exploitation of its capabilities to support space science and applications missions is being initiated through planning and development of larger and heavier spacecraft and payloads. Shuttle-launched spacecraft with larger and expanded instrumentation are expected to play a significant role in increasing our understanding of the universe and the earth. When it is economically or scientifically advantageous, these highly instrumented spacecraft can now be designed to capitalize on the flexibility of retrieval and refurbishment for extended useful life and reuse. GSFC is the appropriate site for the development of these large instruments because it is the lead center for the development, fabrication, integration, and management of science and applications spacecraft in earth orbit. GSFC also possesses the required personnel that are skilled in the related state-of-the-art technology. To fully use this valuable and resident expertise requires the provision of an integration and fabrication facility large enough to accommodate maximum size shuttle flight hardware.

Construction of this facility as an addition to the GSFC spacecraft development complex will provide the capability for processing and integrating spacecraft up to Shuttle payload bay capability, and take advantage of existing support systems. The first elements of the existing facility complex were designed and constructed in the early 1960's to accommodate sounding rockets, Explorers, and other small spacecraft. The facilities were expanded in 1967 to provide for integration of spacecraft for Delta and Centaur sized launch vehicles, and again in 1978 to accommodate shuttle pallet sized instruments of up to 10,000 pounds maximum weight. These GSFC integration and test facilities can be used for major component work, in support of Shuttle-size spacecraft, but current size and weight limitations prevent work on the large flight hardware that can take full advantage of the Space Shuttle's capability. A high bay, laminar flow, clean room is the most critical element of this facility requirement. To meet the stringent requirements of scientific spacecraft and instruments, it must provide a cleanliness standard of class 100 as the air enters the room in order to ensure a class 10,000 environment at the work stations. It often requires up to two years for spacecraft development integration, encompassing physical and electromagnetic testing, functional testing, electronic and optical adjustment, and alignment. Based on current planning, the proposed facility must be able to accommodate the simultaneous integration and/or refurbishment of two spacecraft which permits necessary program overlaps.

The payload processing facilities at the Kennedy Space Center are not designed for and cannot accommodate this type of long term work. They are fully committed to prelaunch processing of shuttle payloads. Existing development contractor facilities do not meet the cleanliness, size and scheduling criteria. This facility will also significantly enhance GSFC's ability to retain and maintain the necessary in-house expertise in research, development, integration, and test activities.

IMPACT OF DELAY:

Delay of this project would adversely impact the full exploitation of the Shuttle's capabilities for NASA research and development spacecraft, by restricting spacecraft development to the present size and weight limited facilities. This facility must be started now in order that developmental spacecraft which can take full advantage of the large Shuttle cargo bay capability can be properly supported.

PROJECT DESCRIPTION:

This project will provide the initial increment of construction of a technical addition of approximately 78,800 gross square feet to the north side of the Building 7/10/15 complex (Figure 1). Long lead structural steel, foundations, some site work and closing in of the building shell will be emphasized during this phase of work. Domestic water, sanitary and storm sewers, communications, steam, chilled water, and electrical power are available and will be extended from existing distribution systems within the appropriate increments.

The facility addition (Figure 2) when completed will include: a 12,500-square foot, 106-foot high bay, laminar flow, clean room; a 1,000-square foot change room for personnel changing into cleanroom attire; a 25,000-square foot flight hardware storage area (includes 5,000 square feet of bonded storage area for long term storage of payload components); a 10,000-square foot two-story support area (includes a 3,500-square foot automatic data processing room for simulating data flow to and from payloads); and an 11,500-square foot staging, shipping and receiving area. This facility will be supported by the existing integration, environmental test, control centers, and data processing capability located in the adjacent Building 7/10/15 complex and elsewhere at GSFC.

The clean room is sized to simultaneously accommodate two full shuttle bay payloads up to 60 feet long, 15 feet in diameter and maximum Shuttle cargo weight. It will also house related ground support equipment and provide adequate access aisles. Two cranes will be installed within the clean room with hoisting capabilities of 35 tons each. Class 100 filtered air (90,000 cubic feet per minute) will enter the clean room at the north side through a floor-to-ceiling, wall-to-wall, high efficiency particulate air filter bank (Figure 3). This filtering system will produce a cleanliness level of at least class 10,000 within all work stations.

This facility will also include a 35-ton crane in the staging, shipping and receiving area; a passenger/freight elevator: a dual type electrical power system to provide redundancy; and a fire protection and utility control system which will be connected to the center wide utility control system.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	8,000,000
Site development	LS	---	---	800,000
Demolition	LS	---	---	150,000
High bay laminar flow clean room	LS	---	---	4,000,000
Change room	LS	---	---	50,000
Flight hardware storage area	LS	---	---	900,000
Shipping, receiving, and staging area	LS	---	---	1,500,000
Automatic data processing and tech. suppt. area	LS	---	---	600,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				8,000,000

NOTE: This cost estimate provides only for the FY 1987 increment of the total facility. The total cost of the project is estimated to be approximately $16,000,000.

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Floor Plans
Figure 3 - Isometric Section
Figure 4 - GSFC Spacecraft History 1960-1992

OTHER EQUIPMENT SUMMARY:

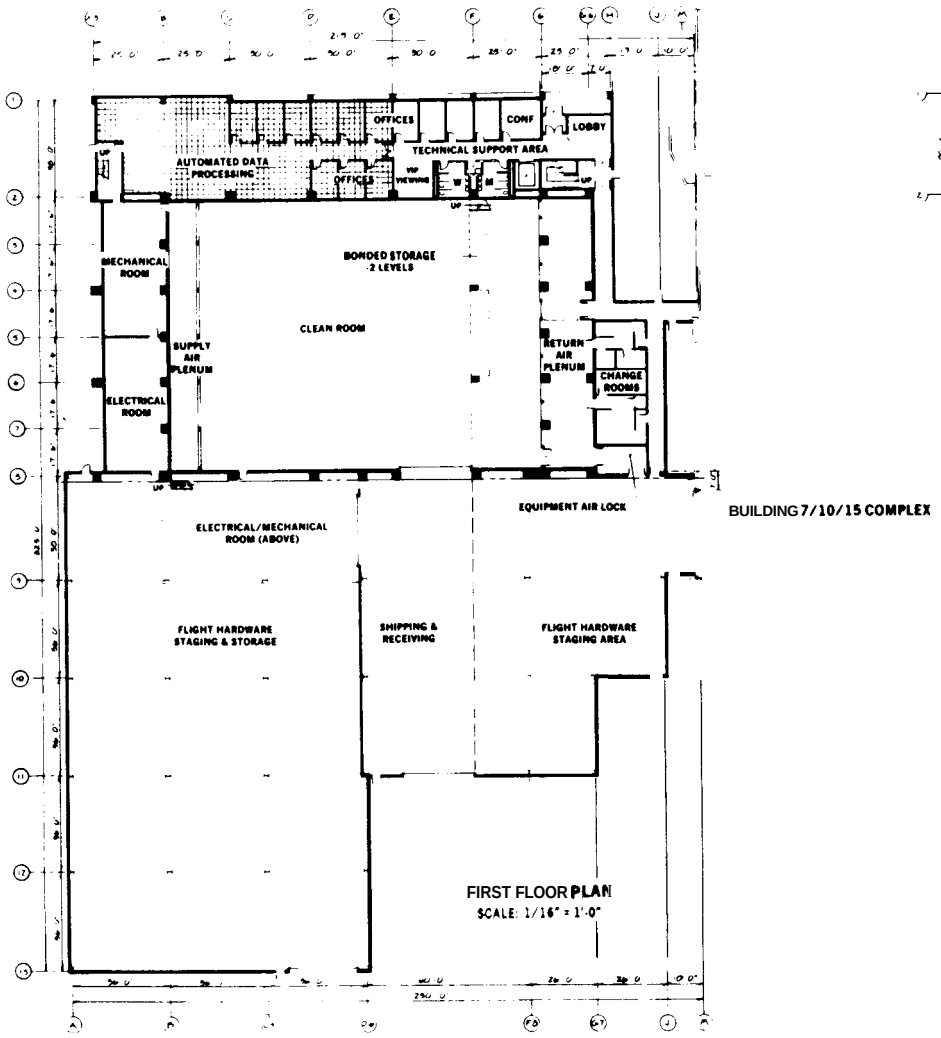
Materials handling equipment estimated to cost $50,000 will be provided from R&PM resources.

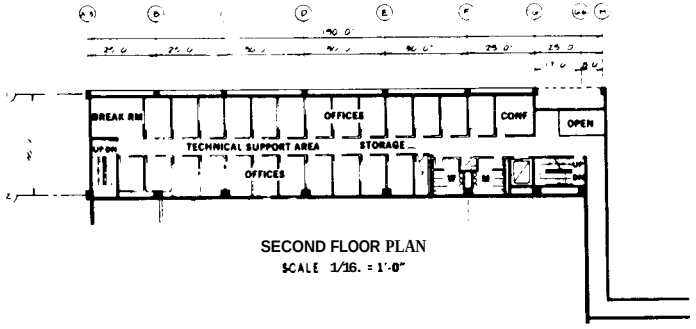
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

To complete this project, a second and final increment will be included in the FY 1988 budget request for an approximately $8 million.

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF SPACECRAFT SYSTEMS DEVELOPMENT AND INTEGRATION FACILITY

FLOOR PLAN





BUILDING 7/10/15 COMPLEX

COMPOSITE FLOOR PLAN

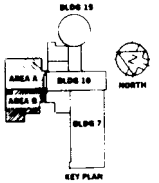


FIGURE 2

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF SPACECRAFT SYSTEMS DEVELOPMENT AND INTEGRATION FACILITY

ISOMETRIC SECTION

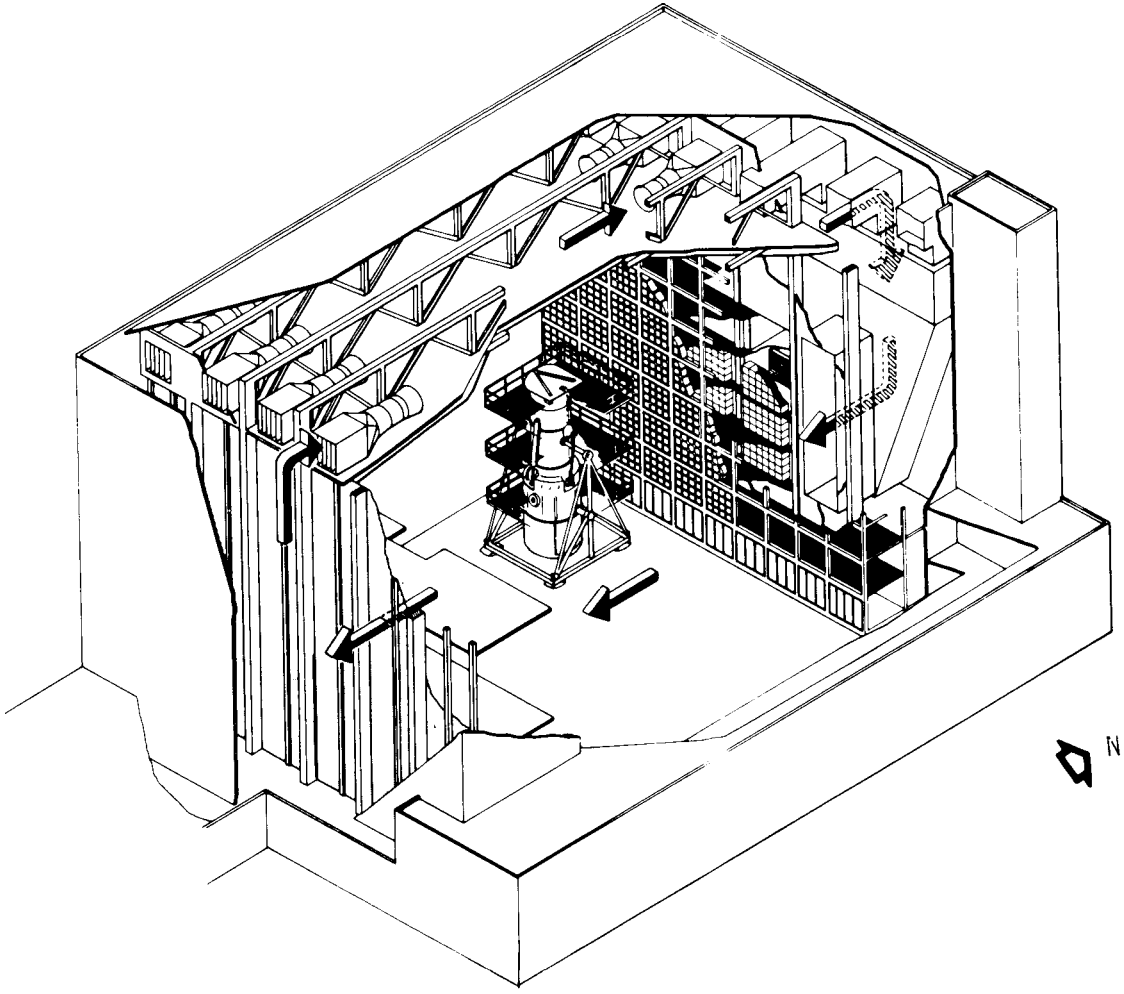


FIGURE 3

JET
PROPULSION
LABORATORY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

JET PROPULSION LABORATORY

Office of Space Science and Applications:	Amount	Page No.
Construction of Engineering Support Building	9,800,000	CF 5-1
Modification of Uninterruptible Power System in Space Flight Operations Facility	2,600,000	CF 5-8
Total	12,400,000	

JET PROPULSION LABORATORY
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ENGINEERING SUPPORT BUILDING

LOCATION PLAN

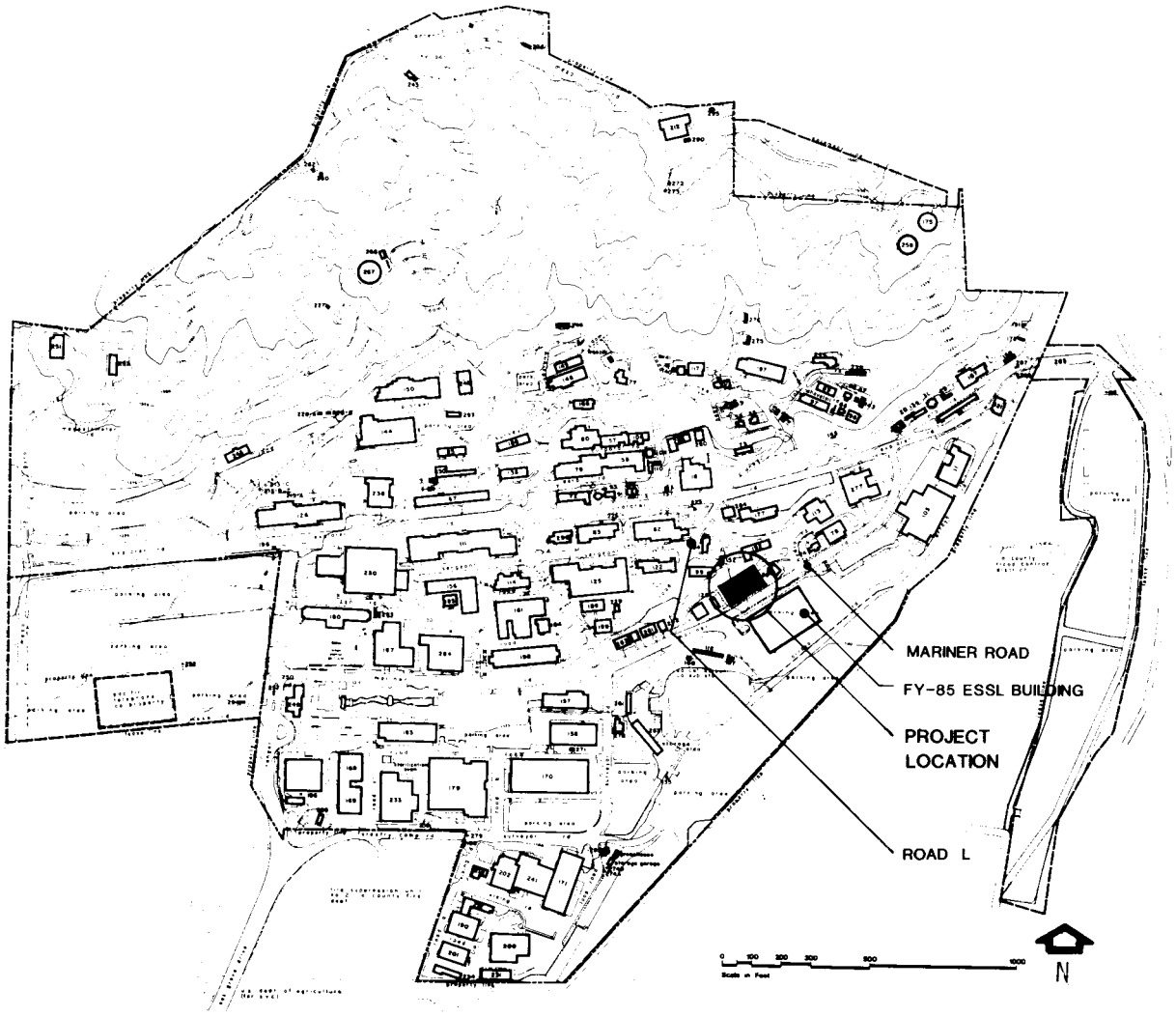


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Engineering Support Building

INSTALLATION: Jet Propulsion Laboratory

FY 1987 CoF Estimate: $9,800,000

LOCATION OF PROJECT: La Canada-Flintridge, Los Angeles County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	588,000	---	588,000
Capitalized investment.....	N/A	---	---
Total.....	588,000	---	588,000

SUMMARY PURPOSE AND SCOPE:

The project provides for the construction of a multi-story, 75,000-square foot engineering support building at the Jet Propulsion Laboratory. The proposed building will contain 40,600 square feet of administrative and engineering space, 17,400 square feet of technical laboratory space and a 17,000-square foot cafeteria with indoor and outdoor seating for 550 people. This building will provide space to house scientists, engineers and their staff who are presently located in expensive off-site leased space, on-site trailers and obsolete sub-standard buildings.

PROJECT JUSTIFICATION:

The Engineering Support Building (ESB) represents a key element of construction that will permit the return of the JPL staff from commercial leased space in Pasadena to the JPL site. This will result in significant improvements in operating efficiency and the elimination of costly leases which are presently required to house JPL personnel off-site. This facility will also permit elimination of seventeen 20-year old office trailers, and the demolition of three substandard structures on-site. This will further improve efficiency and reduce facility maintenance and operating costs.

In the latter half of 1986, off-site leased space will be reduced to approximately 83,000 square feet, serving a population of about 205. Construction of the ESB will permit the return of 180 of these people and the disposal of 60,000 square feet of the leased space in Pasadena. The remaining 25 people and 33,000 square feet of leased space will be maintained for the printing plant and records storage. Construction of the ESB will also permit the demolition of 15,100 square feet of obsolete, substandard space in Buildings 57, 80 and 106. These buildings are expensive to maintain and operate, are energy inefficient, and functionally obsolete. Rehabilitation would be uneconomical. This facility will also permit disposal of 17 trailers totaling 7,600 square feet. Maintenance and operating cost of these 20-year old trailers continues to increase rapidly each year.

The cafeteria facilities at JPL are currently housed in Buildings 167 and 190, and are designed to serve 2,400 meals per day during a 11:15 a.m to 1:30 p.m. lunch period. Both facilities are now serving in excess of 3,000 meals per day. Upon completion of on-going contruction, which will bring personnel on-site from leased space, the population will increase by 14 percent. This will place an even greater load on already overloaded food processing and service facilities. It is essential that this cafeteria be provided to accommodate the on-site population growth.

This project will provide significant savings by moving out of leased space, and eliminating substandard buildings and trailers. Intangible benefits will accrue by providing a more efficient operating environment for personnel resulting in increased productivity. This project will have a simple payback of less than 8 years.

IMPACT OF DELAY:

Delay in implementing this project will force the continued use of inefficient facilities and separate locations and adversely impact the JPL mission. There would be a need to continue to lease and occupy facilities that are distant from the main JPL site at costs exceeding a million dollars per year over the terms of the leases. Without this facility JPL will also have to continue to utilize substandard buildings and trailers which are costly to maintain and operate.

PROJECT DESCRIPTION:

The multi-story 75,000-square foot Engineering Support Building will be constructed of a lightweight steel frame with concrete floors on steel decking. The building is to be enclosed with insulated precast concrete panels and tinted heat absorbing glass. The first floor will house a cafeteria of approximately 17,000 square feet, which includes a kitchen, food storage, and preparation, serving and dining areas. An outside eating area will also be included. All other floors will house office and laboratory areas, with the necessary air-conditioning, utilities, and fire protection systems.

PROJECT COST ESTIMATE:

This cost estimate is based on two preliminary engineering reports.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	9,800,000
Sitework	LS	---	---	663,000
Architectural/structural	SF	75,000	69.60	5,220,000
Mechanical	SF	75,000	38.76	2,907,000
Electrical	SF	75,000	13.47	1,010,000
Equipment	---	---	---	---
Total				9,800,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Project Rendering

OTHER EQUIPMENT SUMMARY:

Approximately $430,000 of R&D funded open office partitions, and security equipment will be required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future funding is required to complete this facility.

JET PROPULSION LABORATORY
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ENGINEERING SUPPORT BUILDING

SITE PLAN

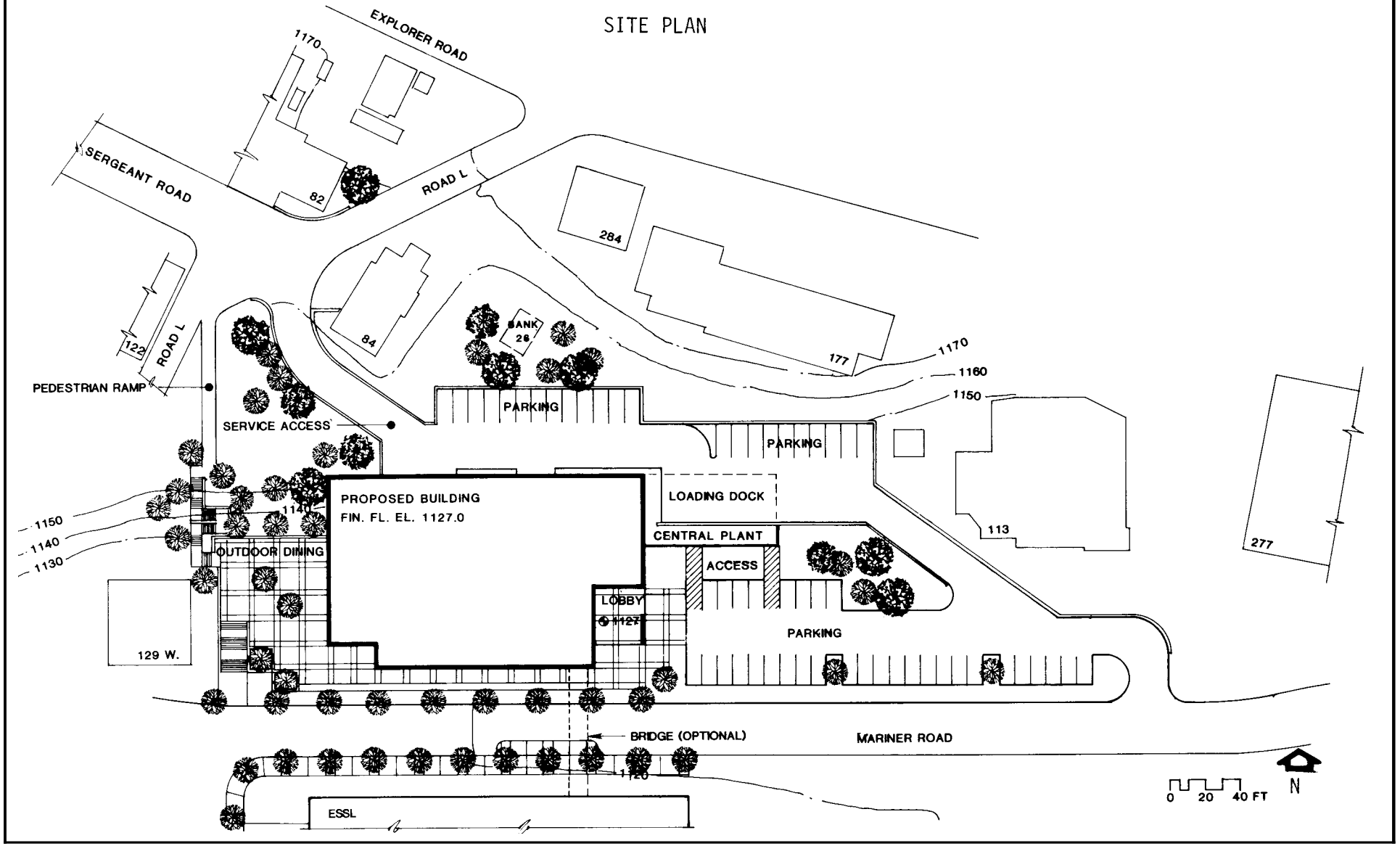


FIGURE 2

JET PROPULSION LABORATORY
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ENGINEERING SUPPORT BUILDING

PROJECT RENDERING

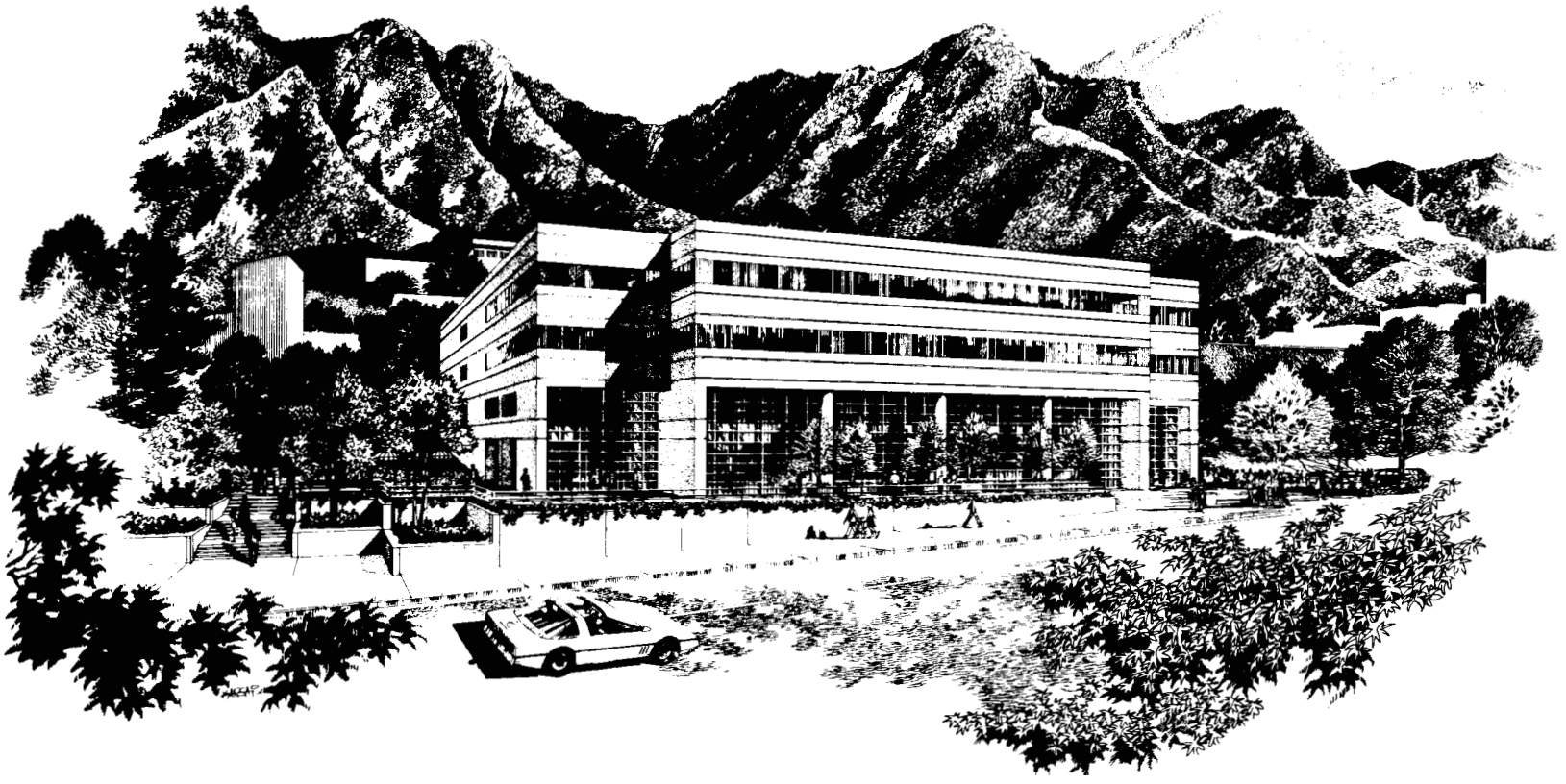


FIGURE 3

JET PROPULSION LABORATORY
FISCAL YEAR 1987 ESTIMATES
FODIFICATION OF UNINTERRUPTIBLE POWER SYSTEM IN SPACE FLIGHT OPERATIONS FACILITY

LOCATION PLAN

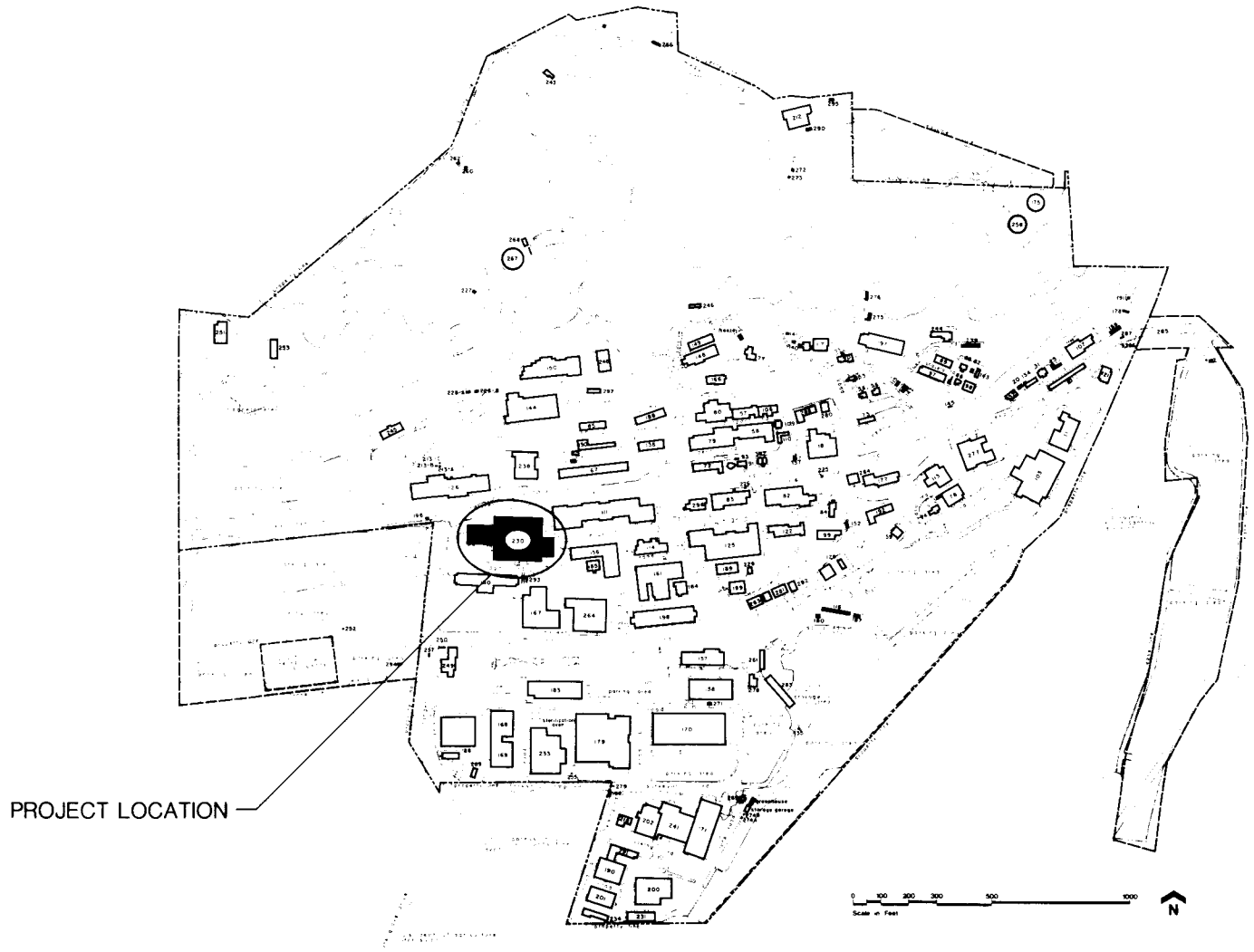


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Modification of Uninterruptible Power System in Space Flight Operations Facility

INSTALLATION: Jet Propulsion Laboratory

FY 1987 CoF Estimate: $2,600,000

LOCATION OF PROJECT: La Canada-Flintridge, Los Angeles County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	204,000	---	204,000
Capitalized investment	N/A	13,120,568	13,120,568
Total	204,000	13,120,568	13,324,568

SUMMARY PURPOSE AND SCOPE:

This project provides for the replacement of the Uninterruptible Power System (UPS) and upgrade of the secondary power distribution system in the Space Flight Operations Facility (SFOF), Building 230. The UPS supports all the critical computer equipment in the facility and is essential for a transient free and continuous source of electrical power. The existing UPS is 21 years old and is no longer manufactured. Spare parts are no longer available. A major failure of this UPS would disrupt the functioning of critical computer and communications equipment required for the operation and control of all planetary exploration spacecraft. This project will also correct low voltage conditions in the secondary power distribution system serving the computing equipment.

PROJECT JUSTIFICATION:

The Space Flight Operations Facility (SFOF) is the central facility at JPL for all data processing systems which track, control, and analyze data from spacecraft. These systems operate 24 hours a day, 365 days a year. The computers which process this data have electrical power tolerances which cannot be met by the commercial power distribution system and are consequently dependent on the UPS to provide a transient free and continous source of electrical power. A failure of the UPS system can cause a catastrophic failure of the computer systems which would severely impact planetary exploration missions such as Galileo and the Venus Radar Mapper (VRM).

The present UPS was one of three manufactured by the same vendor in the mid 1960's, and is the only surviving system of its type in operation. The manufacturer ceased production of this type of system 10 years ago and went out of the UPS business in the late 1970's. This has meant that the source of spare parts, service and technical support has almost totally disappeared. The ages of all of the major components of the system are greater than their normal life expectancy and some of the major components have now operated twice their expected life. The annual maintenance on the system requires it be shut down and the critical loads have to rely on commercial power during these periods. This year the system was down for 5 weeks for the annual maintenance compared to 2 weeks in 1982. Also, in 1982, no major parts required replacement compared to the necessity of replacing 14 major components in 1984. These spare parts had to be cannibalized from existing non-operative systems or made to order.

Voltage as low as 190 volts has been experienced in the 208 volt distribution system due to increasing computer loads. Such low voltage causes computers and their peripheral equipment to either go out of calibration, shut down, or perform erroneously. Data then becomes invalid, leading to serious problems with information transmission and receiving. This project will modify the electrical distribution system to eliminate the low voltage by installing a dedicated power distribution network for all computer systems.

IMPACT OF DELAY:

This project replaces the existing UPS prior to the Galileo Mission's encounter with Jupiter in 1988 and 1989 and the VRM Venus encounter in 1988. A delay of the project could jeopardize these missions, as well as numerous other planned missions which require SFOF support. The FY 1987 time-frame provides an excellent opportunity to shut down the UPS between critical missions. The next available construction opportunity would be in 1992. If the 1987 opportunity is missed, the existing failure-prone system may have to operate for another 5 years, which would greatly increase the probability of failure.

PROJECT DESCRIPTION:

The replacement UPS will be comprised of three 500KW modules, one of which will be redundant, providing a total system rating of 1,000 KW. The new system will include solid state controls, system and control redundancy, and forward and reverse bypass transfer. It will provide 15-minute battery backup, individual module isolation, provisions for periodic testing with load banks, and local and remote alarms. The system will be energy efficient and designed for efficient maintenance. It will also have a 25 percent growth and safety factor. The replacement of the existing UPS equipment will be accomplished within the same area by a phased equipment replacement process.

In addition to the UPS replacement, the building's electrical distribution system will be modified to provide additional capacity necessary to support current and anticipated programmatic growth and increased numbers of computers. This will be accomplished by changing the secondary distribution system from 208 to 480 VAC. The voltage regulators supplying regulated power to the computer systems will be replaced with new state-of-the-art units.

PROJECT COST ESTIMATE:

This cost estimate is based on two preliminary engineering reports.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition..	---	---	---	---
Construction	---	---	---	2,600,000
Sitework	LS	---	---	---
Architectural/structural	LS	---	---	95,000
Mechanical	LS	---	---	225,000
Electrical	LS	---	---	2,280,000
Equipment..	---	---	---	---
Fallout Shelter (not feasible)				---
Total				2,600,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan

OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project.

AMES
RESEARCH
CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

AMES RESEARCH CENTER

Office of Aeronautics and Space Technology:	Amount	Page No.
Construction of Human Performance Research Laboratory..	9,400,000	CF 6-1

AMES RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF HUMAN PERFORMANCE RESEARCH LABORATORY

LOCATION PLAN

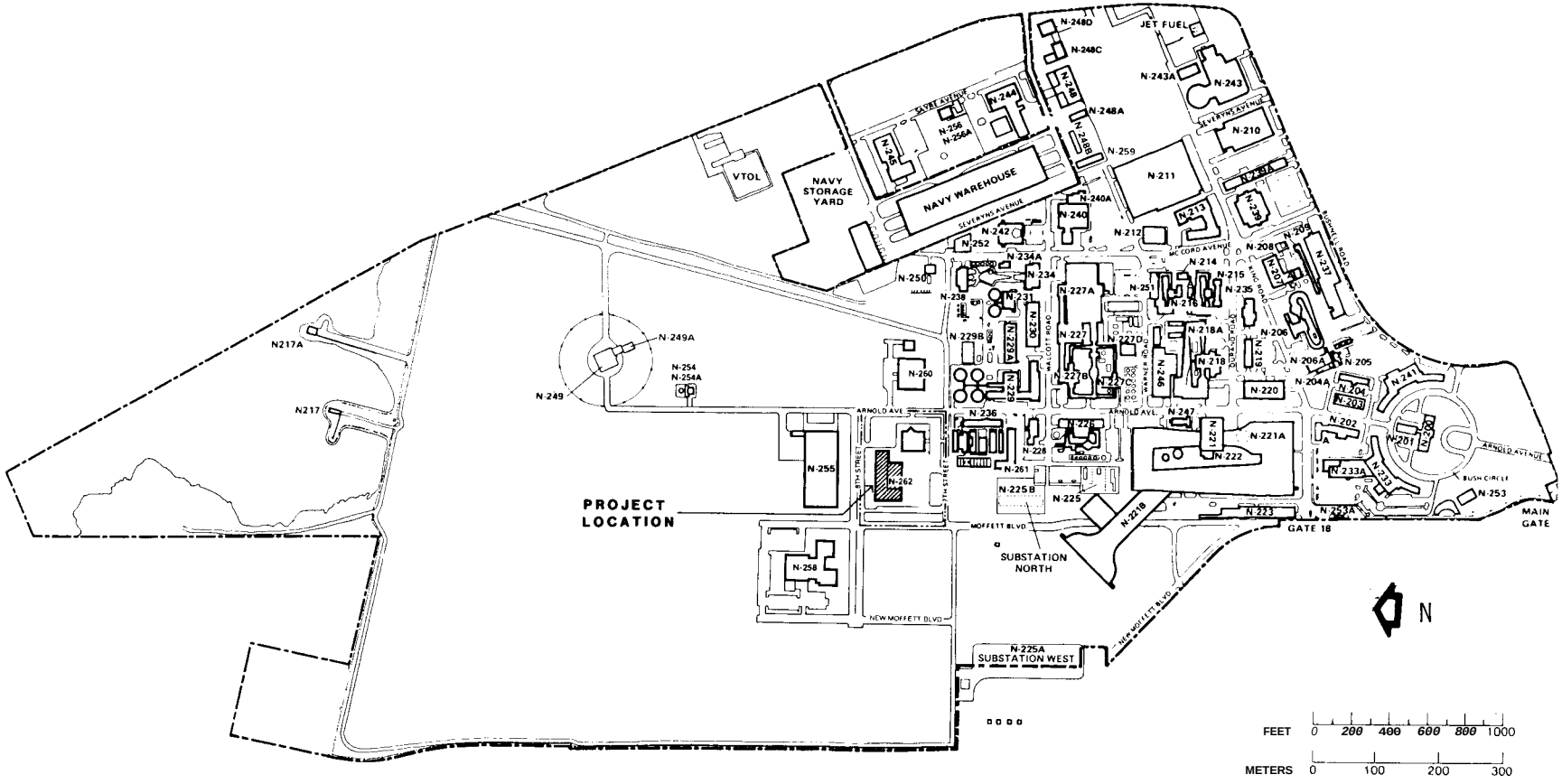


FIGURE 1

CF 6-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Human Performance Research Laboratory

INSTALLATION: Ames Research Center

FY 1987 CoF Estimate: $9,400,000

LOCATION OF PROJECT: Moffett Field, Santa Clara County, California

COGNIZANT HEADQUARTERS OFFICES: Office of Aeronautics and Space Technology

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,000,000	---	1,000,000
Capitalized investment	N/A	---	---
Total	1,000,000	---	1,000,000

SUMMARY PURPOSE AND SCOPE:

The Human Performance Research Laboratory will provide otherwise unavailable laboratory and high bay space required to support NASA's commitment to meet the human factors research needs of a permanent manned presence in space. The 68,500-square foot facility will also provide the space into which the existing disciplinary human factors labs and support areas, already limited by the over-crowded conditions of buildings N239/239A and five trailers, will be relocated. This project will ensure that human resources factors are used to full advantage during future manned space missions and that levels of safety in manned space flight are enhanced through reductions in the incidence and severity of human error.

PROJECT JUSTIFICATION:

This laboratory will house the research activities related to human factors issues associated with long duration manned space flights. To assure the success of missions such as the Space Station, human performance and productivity must be examined and guidelines developed for the engineering and architectural design of the space habitat. Ames Research Center is assigned human factors research responsibility for both the man-in-space and the aeronautical environment. Space and aeronautical human factor problems are virtually identical. Therefore, better understanding of perception and cognition, performance measurement, and man-machine interaction increases human effectiveness and reduces errors in both space and aeronautical environments. This project will provide the facilities to conduct new studies to support a Space Station, and to accommodate continuing studies for man-in-space activities.

The Ames space human factors research plan includes crew interfaces with individual work stations, performance and workload studies, operations and design impact on productivity, and extravehicular activities research and technology. Task and mission studies conducted in flexible Space Station mock-ups will provide the greatest productivity, the least human error in Space Station operations, validate crew-habitat concepts, and minimize the risk associated with Space Station design decisions. This requires basic disciplinary laboratories and flexible station mock-ups. The close proximity of the labs and mock-ups will allow the investigators to develop mock-up studies and experiments with the aid of inexpensive local area network computer technology. The proposed laboratory will be used by approximately 185 people. About 160 of these people are currently at the Center in dispersed and very crowded conditions, many in trailers or other substandard space.

IMPACT OF DELAY:

Space Station architecture and task assignments research cannot be accomplished without a facility for mock-ups, laboratory research, and simulation. Failure to accomplish this research can jeopardize the full success and productivity of the Space Station. The proposed launch date dictates the earliest possible construction to allow maximum development time prior to final design of the Space Station.

PROJECT DESCRIPTION:

This project provides a new 68,500-square foot two-story laboratory and high bay steel frame and concrete building adjoined to existing building N-257 by a covered breezeway. The high bay area comprising approximately 12,000 square feet will house the Space Station mock-ups that will be used for human performance evaluations. Additionally, the high bay will house a staging and assembly area, mock-up support areas, and an evaluation development laboratory. Support areas adjacent to the high bay include a space human factors lab, aeronautical human factors lab, perception and cognition lab, and a central computing laboratory. The second floor will house the human-machine interactions lab, performance assessment lab, additional computer laboratories, along with office and technical support areas. Individual HVAC systems will be provided for the central computer areas. Laboratory, office, and technical support areas will be provided with a separate HVAC system. The project will include site work, additional parking, paving, electrical, plumbing, and support utilities including diesel driven emergency power, conditioned power for laboratory and computer equipment, two separate grounding systems, fire detection and dry pipe suppression system, and a local communications network for remote computer terminal links to the main frame central computers.

PHOJECT COST ESTIMATE:

The current cost estimate is based on a July, 1985 Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	9,400 ,000
Site preparation	LS	---	---	1,100,000
Architectural/structural	SF	68,500	68.61	4,700,000
Mechanical	SF	68,500	36.50	2,500,000
Electrical	SF	68 ,500	16.06	1,100,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				9 ,400,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Evaluation and Site Plan
Figure 3 - Cut-Away Schematic

OTHER EQUIPMENT SUMMARY:

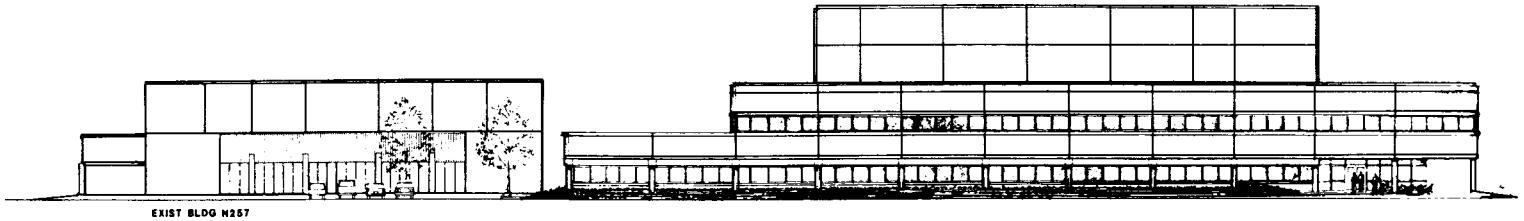
Computer and laboratory equipment will be relocated from other buildings. Elements of the Space Station mock-ups will be relocated from other sites on the center and assembled in the high bay area.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future Cof funding is required to complete this project.

AMES RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF HUMAN PERFORMANCE RESEARCH LABORATORY

SITE PLAN



NORTH ELEVATION

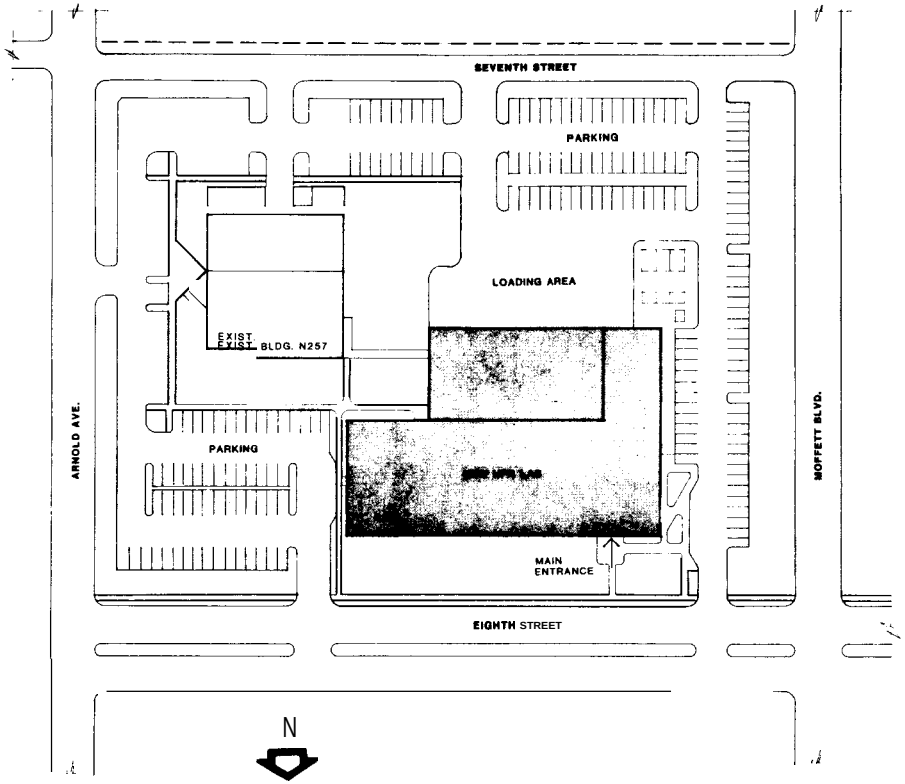


FIGURE 2

AMES RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF HUMAN PERFORMANCE RESEARCH LABORATORY

CUT-AWAY SCHEMATIC

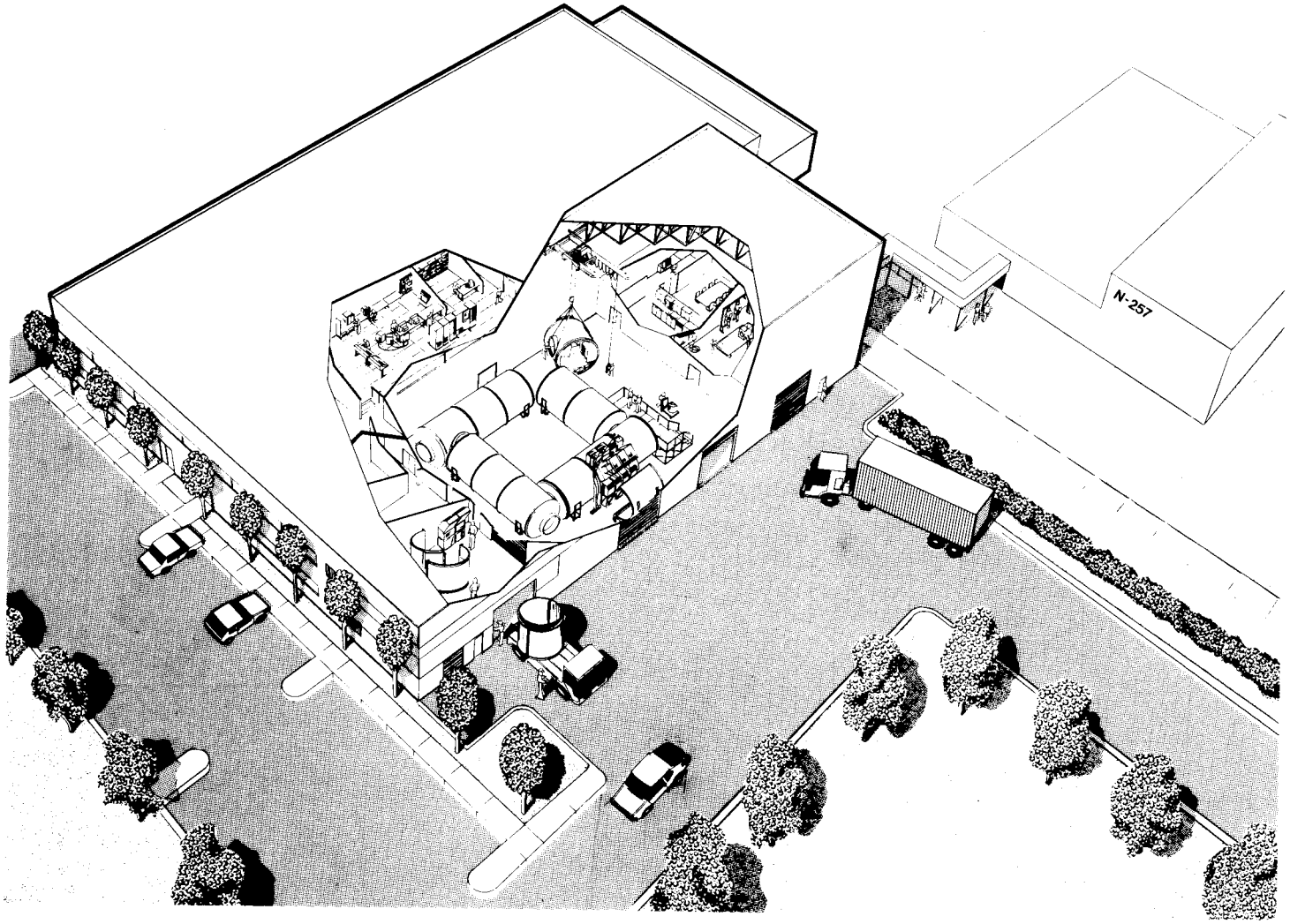


FIGURE 3

DRYDEN
FLIGHT RESEARCH
FACILITY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

DRYDEN FLIGHT RESEARCH FACILITY

Office of Aeronautics and Space Technology:	Amount	Page No
Construction of Interstate Test Facility	17,500,000	CF 7-1

DRYDEN FLIGHT RESEARCH FACILITY
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF INTEGRATED TEST FACILITY

LOCATION PLAN

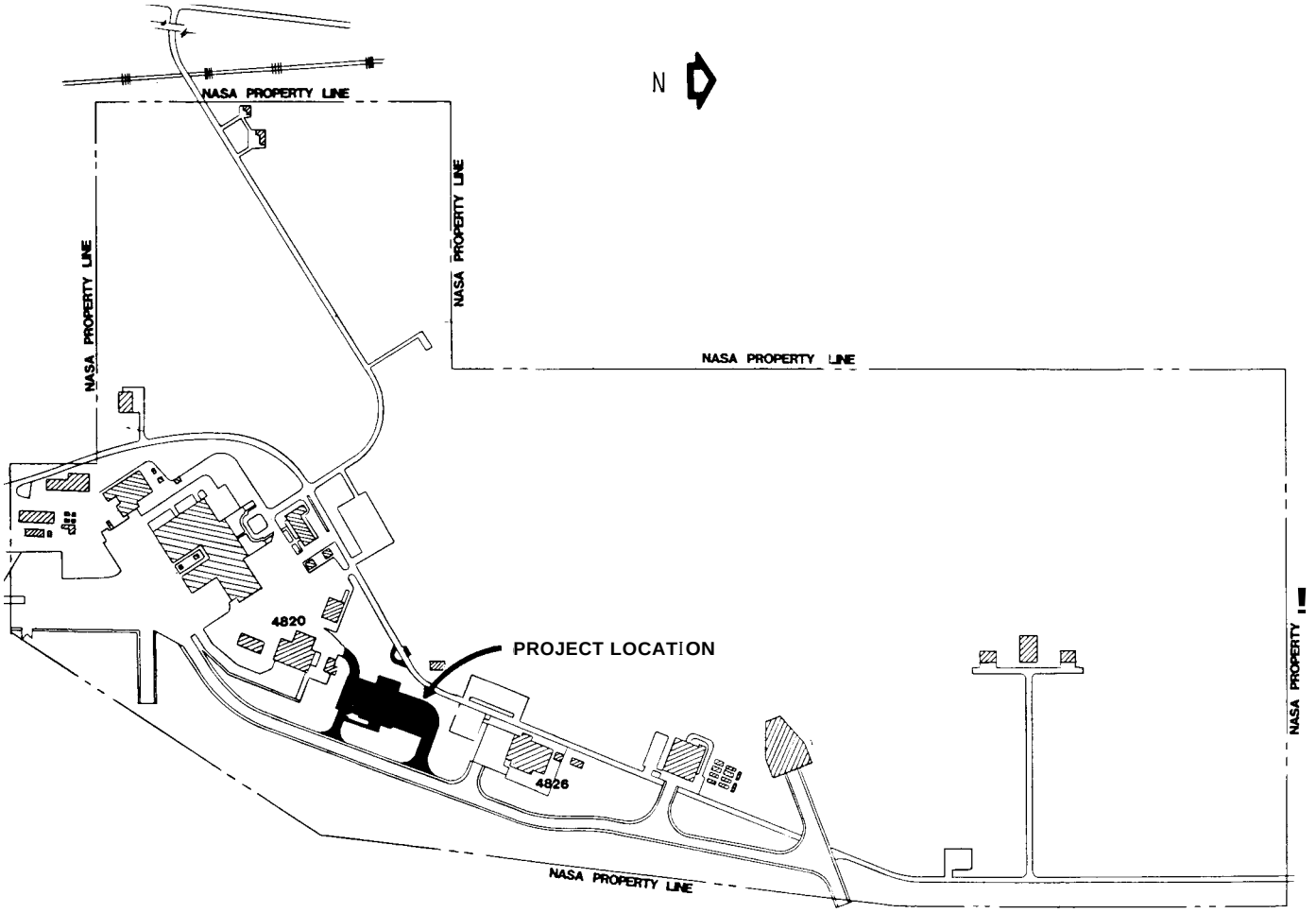


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Integrated Test Facility

INSTALLATION: Dryden Flight Research Facility

FY 1987 CoF Estimate: $17,500,000

LOCATION OF PROJECT: Edwards AFB, Kern County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding...	1,200,000	---	1,200,000
Capitalized investment...	N/A	---	---
Total...	1,200,000	---	1,200,000

SUMMARY PURPOSE AND SCOPE:

The Integrated Test Facility (ITF) is essential for NASA to maintain its pre-eminence in aeronautical research. The last decade has seen an exponential growth of electronic digital control for aircraft systems. Vehicles are being designed with integrated systems for flight control, fire control, flutter suppression, flight management, etc. The ITF will accommodate checkout of each component and the interaction between components during closed loop operations of the overall integrated system. An adequate ground testing facility for these highly integrated and interactive systems does not currently exist at the Dryden Flight

Research Facility. This project will provide aircraft test areas and computer laboratory space required for the complex testing of these highly interactive systems in both the aircraft of today, and those of tomorrow.

PROJECT JUSTIFICATION:

NASA requires an Integrated Test Facility (ITF) for developmental testing of systems driven aircraft (i.e. aircraft dominated by digital flight control systems) prior to and during the flight test program. Based on the number of programs involving these types of aircraft, the increased degree of interaction between systems, and the dominance of the systems over aircraft flight behavior, it will be highly inefficient at best to continue to support these flight programs with the current facilities which are separated in approximately eight different locations and are not suitable for support of total systems integration testing.

Systems driven aircraft are characterized by large numbers of interacting systems, some involving crucial flight safety functions, and by the flight control functions having dominance over the aircraft dynamics. To develop, qualify or troubleshoot systems of this type, three conditions must be met: 1) capability for progressive testing complexity; 2) the test aircraft must eventually be tied into the simulation and ground based systems; and 3) the ground test equipment, gear and simulation equipment must be in close proximity to the systems undergoing test.

Existing facilities are only able to support a limited number of system driven aircraft. Even this limited capability assumes that test equipment requirements are similar to those of previous programs. This has the effect of forcing each new program to purchase specialized test equipment to meet the needs of new requirements. Another deficiency is marginal or no signal communications links between aircraft, simulation laboratories, and the remote testing areas. No capability exists for operating an engine while exercising the flight control loops through the aerodynamic simulations. This is critical for aircraft with integrated flight propulsion control systems. No capability now exists to check out special sensor devices such as laser gyros and infrared sensors. There is no Electromagnetic Interference (EMI) shielding from background radiation during calibration tests, nor to prevent unauthorized satellite capture of secure radiation patterns. Also, ground vibration, moment of inertia, and aeroservoelastic ground testing are limited by a lack of environmentally controlled test areas and hangar space with adequate height and strength to support dynamic testing of structural components, as well as the entire aircraft.

New aircraft targeted for introduction in the 1990's will all be systems driven aircraft. Along with the new aircraft, for example the X-29 and the AFTI-16, rapid advancement in avionics technologies are foreseeable and expected. These advancements will lead to requirements that cannot be supported by the present facilities, such as, testing integrated aircraft systems and assessing system interactions, and interrogating avionics and software intensive systems.

IMPACT OF DELAY:

NASA currently has no facility capable of integrated system testing. Existing facilities can provide complex tests on simple systems, but not complex tests on complex systems. Without an integrated testing capability, more risks will be incurred in flight; a "mini - ITF" must be developed for each specific program at higher costs; all tests must be conducted in piecemeal fashion; development and qualification time will be extended; and higher risk flight testing will be required to qualify systems.

PROJECT DESCRIPTION:

This project provides for construction of a 112,000-square foot Integrated Test Facility composed of six (6) aircraft hanger-type test bays totaling 53,000 square feet and an ajoining 59,000-square foot two-story masonry structure housing computer, laboratory, office, and technical support areas. Each of the six test bays will be large enough to house conventional and/or experimental type fighter or research aircraft, or three bays can be opened to accommodate large aircraft. Each test bay will be provided with: data bus and discrete interface control and logic points, power (115VAC, 208VAC, 28VDC, 270VDC at 400 Hz and 60Hz), cooling air for aircraft systems, hydraulic support systems, ambient heating systems, industrial waste collection systems, fire suppression, shop air, overhead cranes, and shielding. At least one bay will be provided with EMI shielding to protect sensitive electronic systems from externally generated electromagenetic radiation. The laboratories and shop areas, will be provided with power, HVAC, plumbing, fire detection and suppression, a central 4,000 psig hydraulic system manifolded through-out the complex, compressed air, lighting, and emergency power. Also to be provided is a building grounding system including separate aircraft test system grounds, lightning protection, paving, taxiways, parking, and landscaping.

PROJECT COST ESTIMATE:

The current cost estimate is based on a June 1985 Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	17,500,000
Civil	LS	---	---	2,100,000
Architectural/structural	SF	112,000	86.60	9,700,000
Mechanical	SF	112,000	35.71	4,000,000
Electrical	SF	112,000	15.18	1,700,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				17,500,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Interior View

OTHER EQUIPMENT SUMMARY:

Computer equipment and aircraft test equipment is presently at Dryden and will be supplemented with equipment purchased with $2,900,000 of FY 1988 and 1989 R&D funds.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No additional CoF funding is anticipated to complete this project.

DRYDEN FLIGHT RESEARCH FACILITY
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF INTEGRATED TEST FACILITY

INTERIOR VIEW

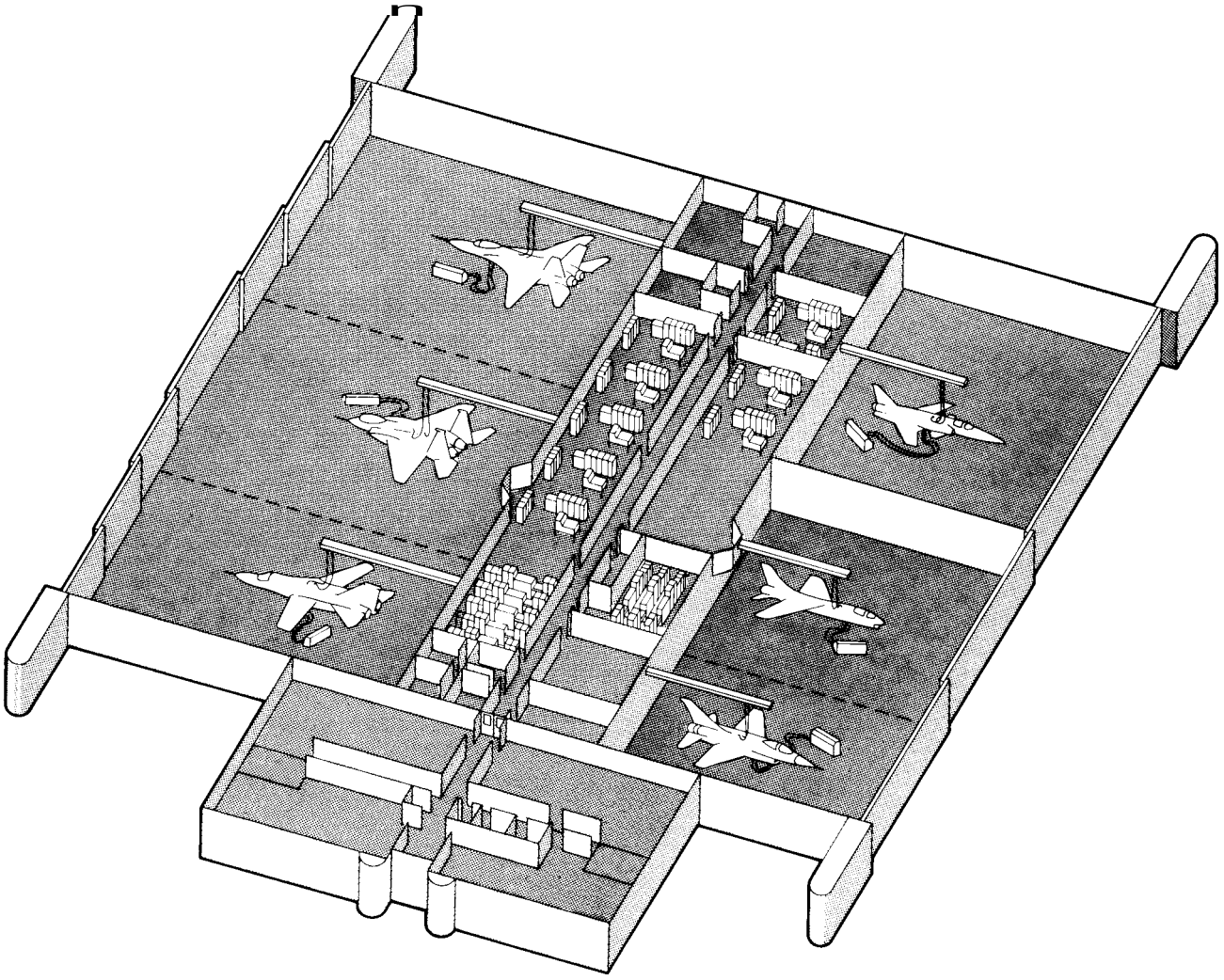


FIGURE 2

LANGLEY
RESEARCH
CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

LANGLEY RESEARCH CENTER

Office of Aeronautics and Space Technology:	~~Amount~~	~~Page No.~~
Modifications to 8-Foot High Temperature Tunnel..	9,700,000	CF 8-1
Construction of Addition for Non-Destructive Evaluation Research Laboratory	2,000,000	CF 8-8
	11,700,000	

LANGLEY RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
MODIFICATIONS TO THE 8-FOOT HIGH TEMPERATURE TUNNEL

LOCATION PLAN

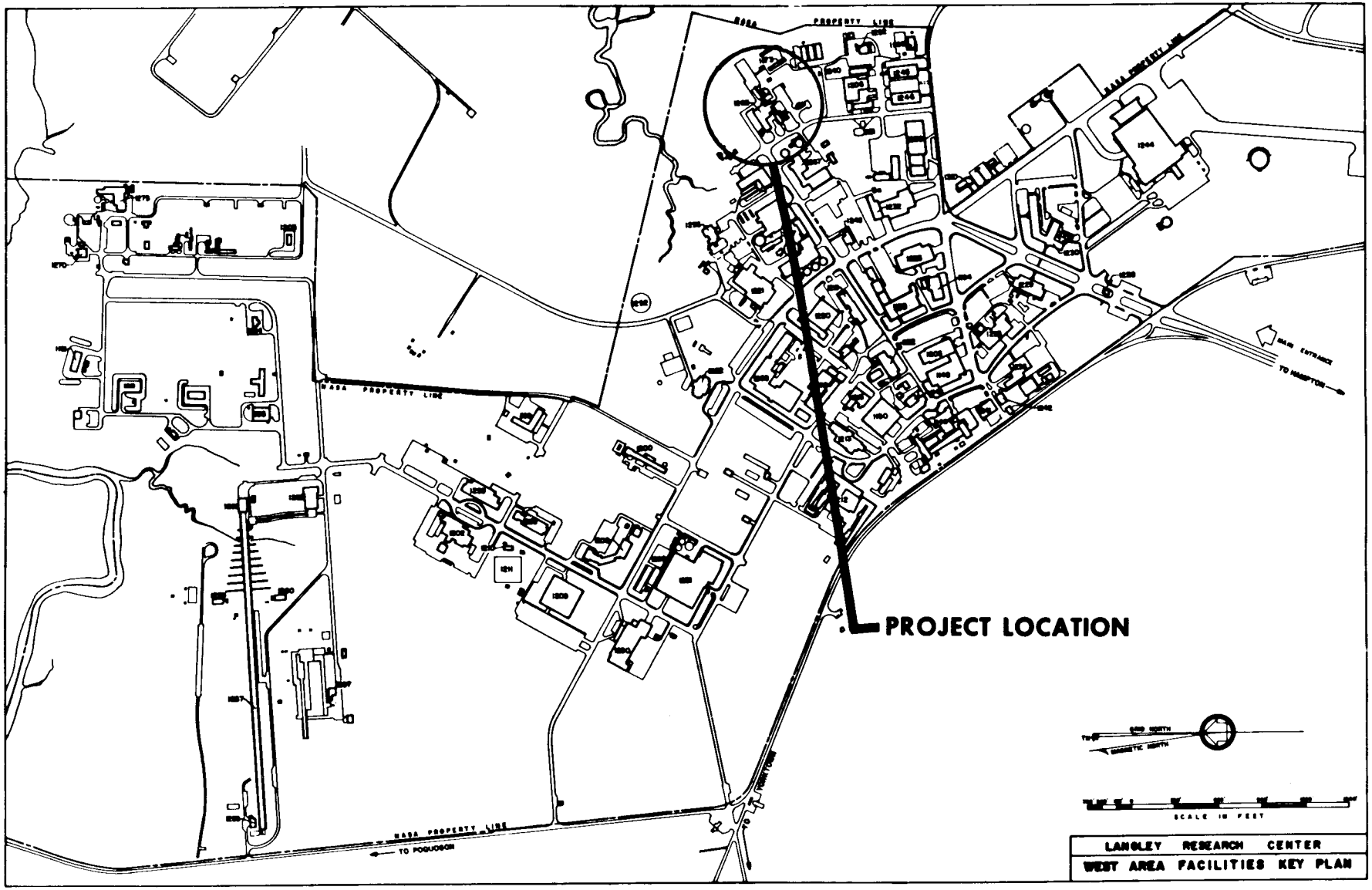


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Modifications to 8-Foot High Temperature Tunnel

INSTALLATION: Langley Research Center

FY 1987 CoF Estimate: $9,700,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,839,000	13,800,000	15,639,000
Capitalized investment	N/A	14,537,666	14,537,666
Total	1,839,000	28,337,666	30,176,666

SUMMARY PURPOSE AND SCOPE:

This project will complete necessary modifications to the 8-foot High Temperature Tunnel (HTT) to advance supersonic and hypersonic research capability. The project, when completed, will provide a unique national research facility capability for hypersonic propulsion and aerothermostructural research for transatmospheric vehicles and missiles at altitudes from 50,000 feet to 130,000 feet with nominal Mach numbers between 4.0 and 7.0. This follow-on increment of construction involves: (1) replacement of high pressure methane compressors, (2) installation of high-speed video cameras, (3) the addition of a flow mixer and two new interchangeable nozzles to expand test simulation capability from the existing nominal Mach 7.0 down to Mach 4.0, and (4) installation of additional controls and instrumentation.

PROJECT JUSTIFICATION:

Capability in this country for testing air breathing propulsion and missile systems over the nominal Mach number range of 4.0 to 7.0 is severely limited. Existing facilities, such as the Arnold Engineering Development Center (AEDC) Aero Propulsion Test Unit (APTU) and Aero Propulsion System Test Facility (ASTF) can only accommodate full-scale ramjets and missiles up to about Mach 4. Other test facilities that can simulate flight Mach numbers up to 7, are too small and can accommodate only incomplete subscale engines or components. The 8-Foot High Temperature Tunnel (HTT) (Figure 2), is the only existing facility that can be modified to provide the required full scale testing capability through the range of Mach 4-7. A comparison of the proposed operational envelope of the 8-Foot HTT compared to that of the AEDC's (APTU) and (ASTF) is shown in Figure 3.

LaRC has, for many years, been developing a technology base for hydrogen and hydrocarbon scramjets at high Mach number conditions and has conducted many evaluations on incomplete subscale engines. The modifications included in this project were originally a part of the FY 1985 CoF project authorized at $13.8M. The FY 1985 project's scope and budget were based on a preliminary engineering report that outlined the modifications necessary to provide the stated requirements. During final design the tunnel computer simulations and pilot tunnel testing were finalized. The results clearly surfaced that the technical complexity of satisfying essential requirements was found to be seriously underestimated. Testing and simulations clearly indicated that by expanding original criteria and requirements, a much more useful performance envelope for the tunnel could be achieved. Similarly, the testing and simulations showed that the earlier requirements had been compromised. Detailed safety reviews, and third party performance reviews also resulted in necessary revisions of the original requirements; especially those concerning the LOX supply and distribution system and tunnel system controls. In summary significant cost increases were necessary and resulted from changes within three general categories: a) operational enhancement and criteria, b) safety analysis and third party review, and c) detailed design integration improvement.

After detailed review and study of the situation, NASA has determined that the enhanced design is significantly more beneficial for basic research. The original FY 1985 project at $13.8M upgrades the 20-year old facility to reestablish the tunnel baseline configuration at Mach 7.0 with new transpiration cooled components, and provides O_2 enrichment that will provide a new capability for propulsion testing. This FY 1987 project will complete the tunnel improvements by expanding the test capability down to the Mach 4 and 5 region. Full scale testing will now be possible at the critical transition region between that of a ramjet and scramjet. For the first time there will be a full scale propulsion test facility capable of testing throughout the entire range of ramjet/scramjet propulsion systems. Also full-scale tests will be possible to evaluate a complete flight-weight, flight scale air breathing engine system and to determine integrated engine component interactions, cooling performance, thermal structural performance, and engine-airframe interaction effects.

IMPACT OF DELAY:

Delay of this project would have a significant impact on providing a facility capable of providing the research environment necessary for NASA's basic research associated with scramjet propulsion systems. Also affected would be delays in proposed DOD missle development programs. Without these modifications the existing tunnel cannot provide the capability of testing at the MACH 4 and 5 conditions which is absolutely cruical for transition research between ramjet and scramjet-flight.

PROJECT DESCRIPTION:

Modifications include fabrication and installation of a new alternate mach number mixing chamber to condition the gas flow at the basic MACH 7 flow before expansion to lower Mach numbers when required. Two additional nozzles nominally rated at Mach 4.0 and 5.0, respectively, will be provided for attachment to the alternate mach number mixer to provide lower mach flows to the existing Mach test chamber flow. An existing 6000 psig air supply line will be extended, enhanced controls will be provided, 25-year old methane compressors will be replaced, and a new high quality high speed computer controlled video camera system will be installed in the tunnel to improve productivity by allowing for real time data validation and verification.

PROJECT COST ESTIMATE:

Project cost estimate are based on final design and 3rd party cost validations.

	Unit of Measure	Quantity	Unit cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	9,700,000
Methane compressors	LS	---	---	632,000
High -speed TV system	LS	---	---	292,000
Alternate mach numbers	LS	---	---	7,222,000
Controls	LS	---		1,418,000
Checkout	LS	---	---	136,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				9,700,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Comparison of Operational Envelope for LaRC's 8-Foot HTT and AEDC Propulsion Facilities (ASTF and APUT)

OTHER EQUIPMENT SUMMARY:

Approximately $1,850,000 of R & D funds will be required for Data Acquisition Systems.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is anticipated to be required to complete this project.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
MODIFICATIONS TO THE 8-FOOT HIGH TEMPERATURE TUNNEL

SITE PLAN

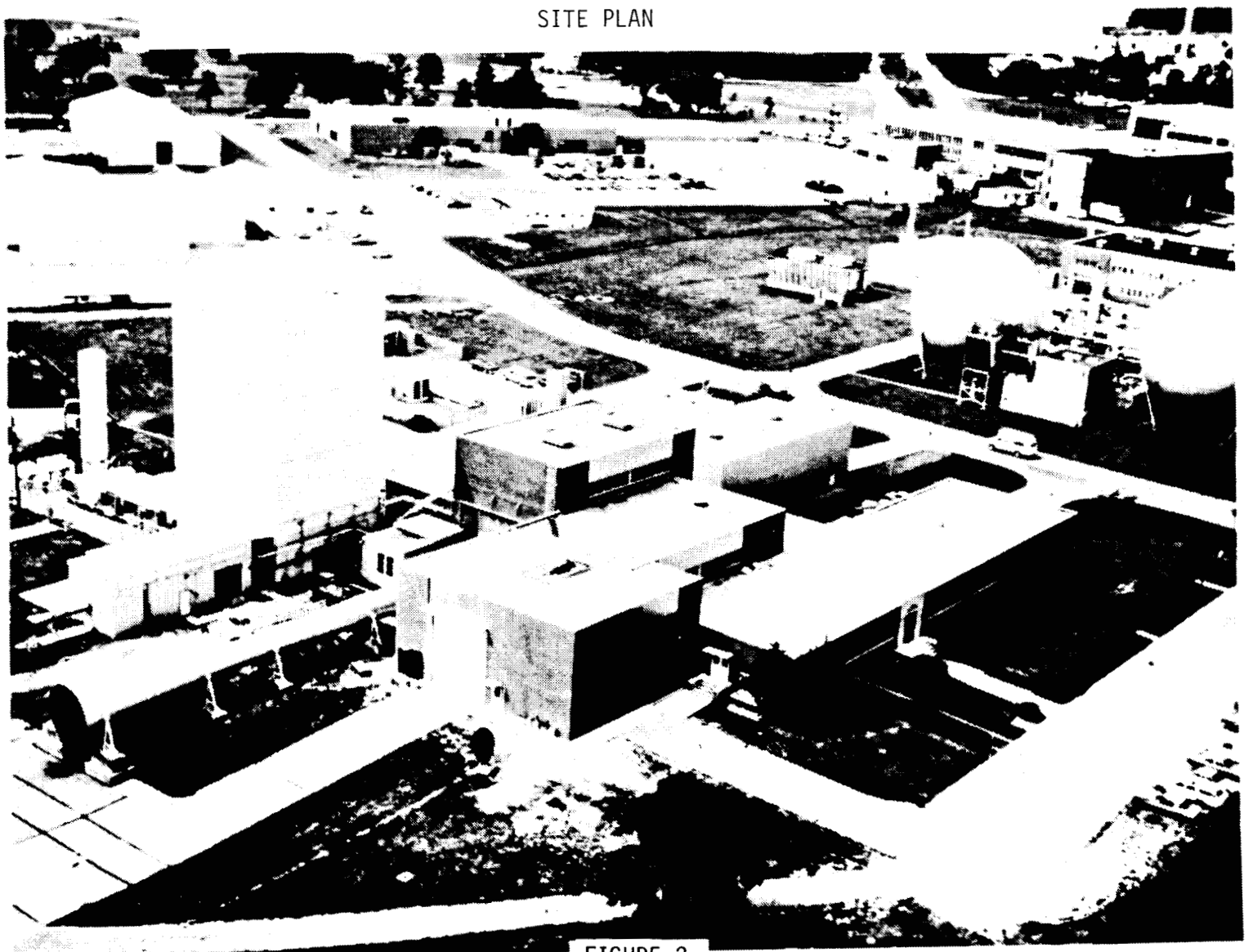


FIGURE 2

LANGLEY RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
MODIFICATIONS TO THE 8-FOOT HIGH TEMPERATURE TUNNEL

COMPARISON OF OPERATIONAL ENVELOPES FOR LaRC'S 8-FOOT HTT AND AEDC PROPULSION FACILITIES (ASTF AND APTU)

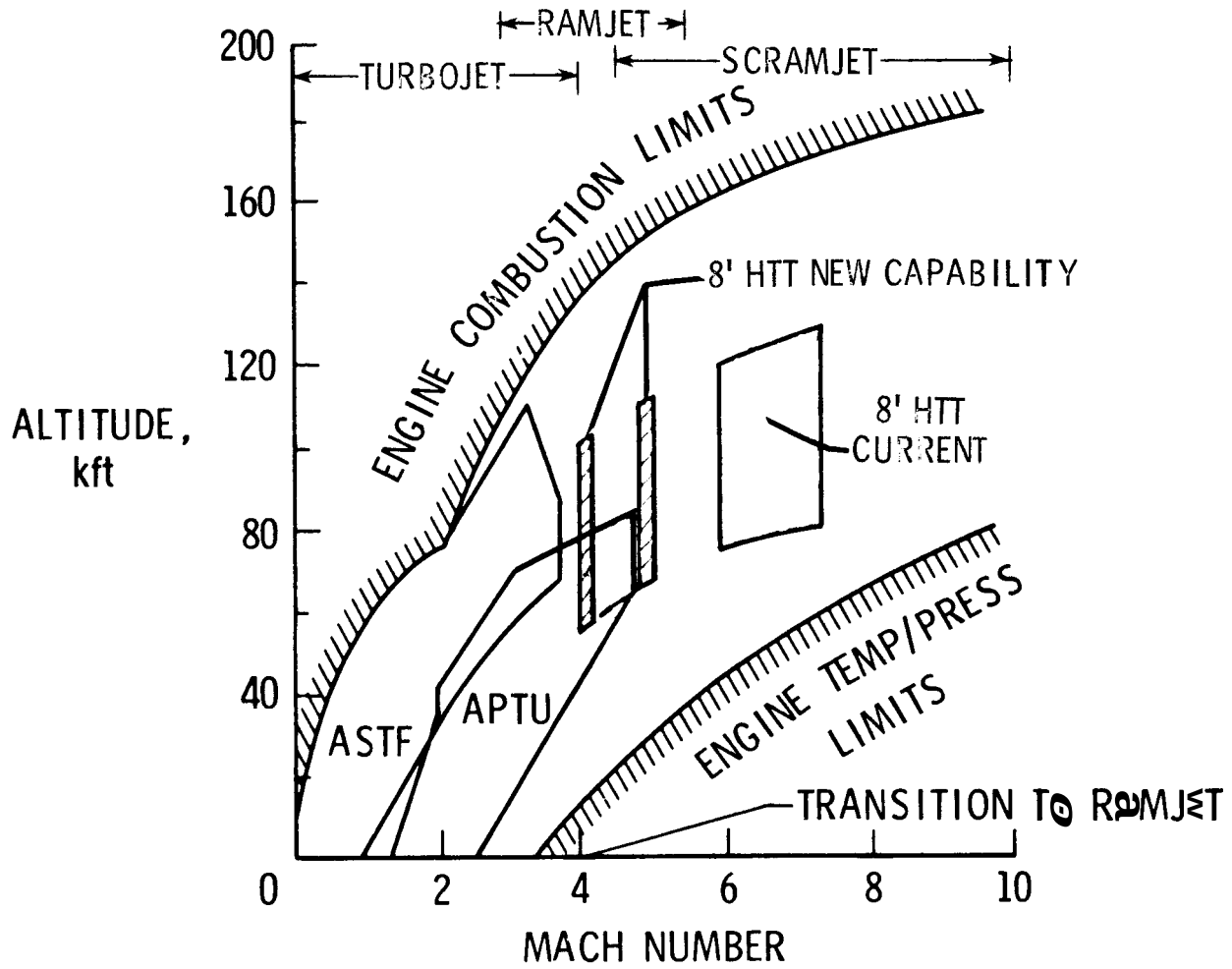


FIGURE 3

LANGLEY RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION FOR NON-DESTRUCTIVE EVALUATION RESEARCH LABORATORY (1230)

LOCATION PLAN

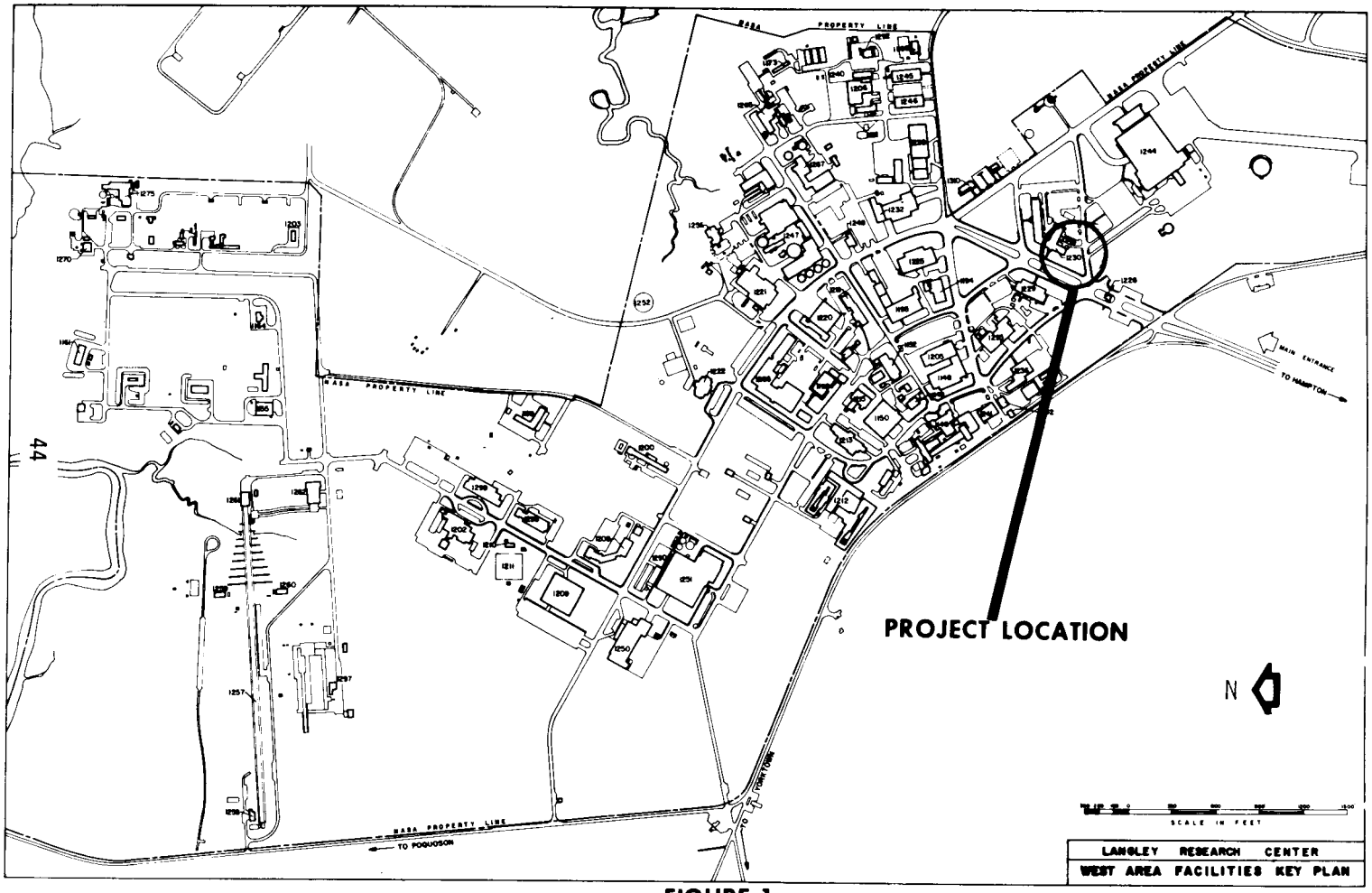


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of Addition for Non-Destructive Evaluation Research Laboratory

INSTALLATION: Langley Research Center

FY 1987 CoF Estimate: $2,000,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology, Office of Chief Engineer

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	192,560	---	192,560
Capitalized investment	N/A	3,499,532	3,499,532
Total	192,560	3,499,532	3,692,092

SUMMARY PURPOSE AND SCOPE:

This project will provide a two-story addition to Building 230 to accommodate a Non-Destructive Evaluation (NDE) Laboratory capable of housing state-of-the-art instrumentation for research in quantitative materials characterization. Aerospace material selection is important for all major structures and other critical components such as solar power systems, optical systems, and thermal control surfaces. This facility will include a laboratory for remote strain and high-resolution sensing, and for development of an energy probe capable of remotely monitoring large space structures to study geometry, vibrational modes, local stress

fields, velocity, and accelerations. It will also provide space for supportive NDE research for aircraft parts, materials evaluation, and recertification programs.

PROJECT JUSTIFICATION:

This facility will provide new capability for non-destructive evaluation (NDE) research programs which are focused on improving the interpretability of research data by advancing the state-of-the-art in instrumentation, physical measurement, and analysis. Examples of critical government, and industry programs requiring the advanced NDE technology that will be developed in this laboratory are those for filament-wound composites (FWC), solid rocket motors (SRM), control of flexible structures (COFS), mobile satellite (MAST), Space Shuttle thermal protection systems (TPS), Space Station, large antennas, advanced composite aircraft, and ground facilities recertification. Improvements in these programs require identification of failure paths and modes before they become critical. This is not possible with existing technology. Recent advances in quantifying the physics of the measurement process have produced many new promising concepts for NDE. However, these measurement advances must be transfered to specific applications. For example, such improvements would have application in the integration of composite materials into critical components of aerospace structures. Also, electronic type failures recently experienced with several satellites such as Westar VI and Solar MAX could possibly be prevented in the future if new NDE practices can be perfected.

This facility addition will include a space-structure sensors/instrumentation lab to develop advanced measurement technology practices. Research will focus on remote sensing of structural integrity through noncontacting strain readout and acoustic emission sensors. New X-ray tomography equipment will help build a better science base for X-ray tomography by increasing the understanding of the measurements being made and then reducing the data to a form which describes the physical properties of a structure. A new twin robotic scanner system will be used to demonstrate the application of new nonlinear and multiparameter ultrasonic techniques for complex aerospace structures. As aerospace structures become more complex no single NDE measurement will be able to certify the integrity of a structure. This laboratory will allow research into the characterization of structures by integration of fundamentally different, yet complimentary, techniques.

IMPACT OF DELAY:

A delay in the construction of this laboratory addition will cause unacceptable delays in the development of the NDE and quantitative physical characterization (QPC) programs for measurements required to insure the integrity of advanced space systems. Recent problems, both on the ground and in space, point to the fine threshold between success and failure when requirements push structures to the limits of design. A significant increase in R&D equipment and staff for both NDE and QPC is included in current plans. Without this laboratory, Langley will not be able to house new research equipment.

PROJECT DESCRIPTION:

The project will provide a 16,600-square foot two-story addition to Building 1230 to house state-of-the-art research equipment for materials evaluation. Included will be a 1 600-square foot high-bay research area.

In addition to the high-bay there will be laboratories for process control, remote strain sensing development, sensor instrumentation, acoustic emission, and electromagnetic interaction, and approximately 2,000 square feet of office and support space. Associated heating, ventilating, air-conditioning, and other related utilities will be provided as needed.

PROJECT COST ESTIMATE:

Project cost estimates are based on a July 1985 preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	2,000,000
Architectural/Structural	SF	16,600	75.30	1,250,000
Mechanical	LS	---	---	505,000
Electrical	LS	---	---	245,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total *				2.000.000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Concept Layout of Proposed Addition

OTHER EQUIPMENT SUMMARY:

R&D funds totalling approximately $1M are planned for research equipment.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION FOR NON-DESTRUCTIVE EVALUATION RESEARCH LABORATORY (1230)

SITE PLAN

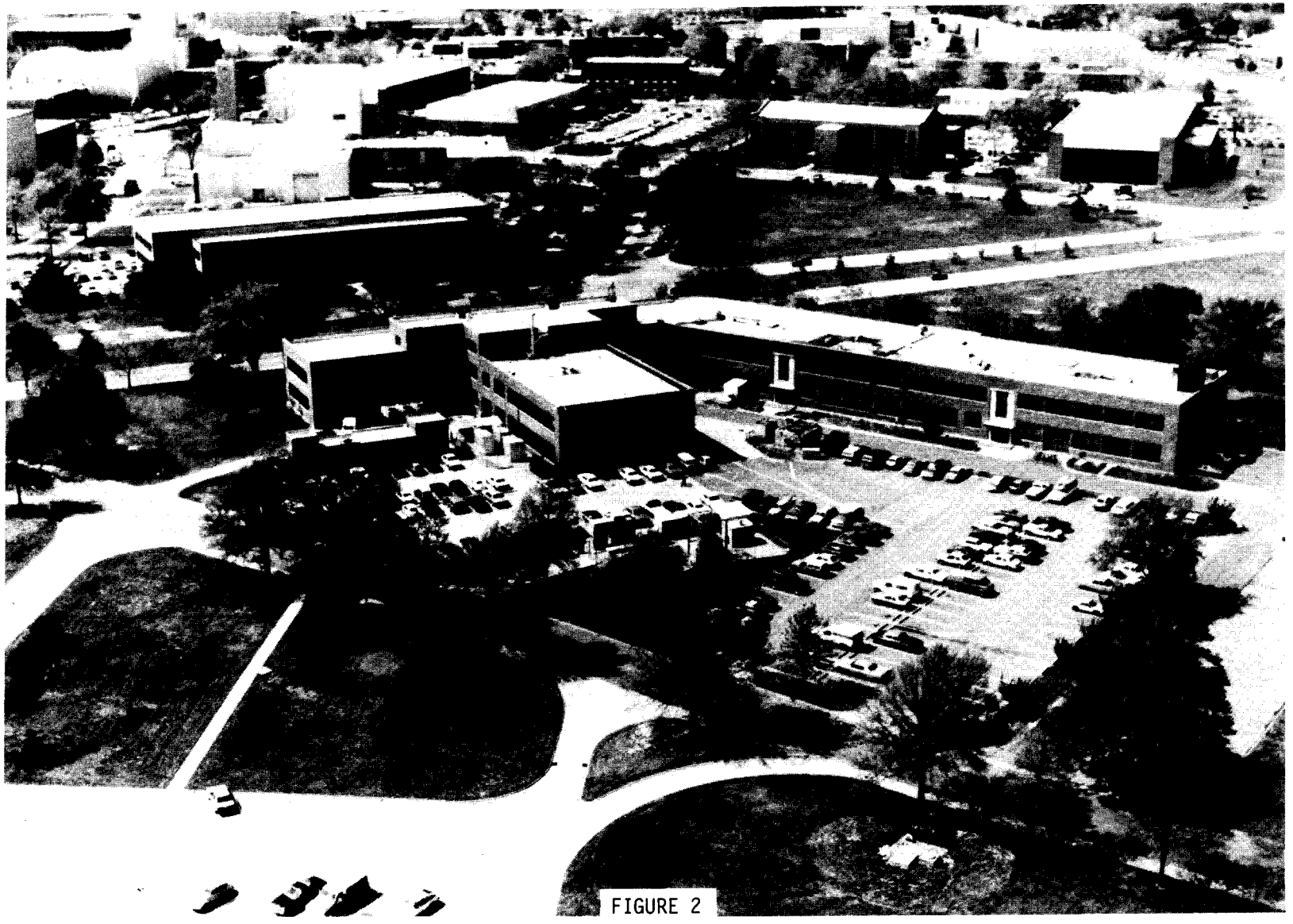
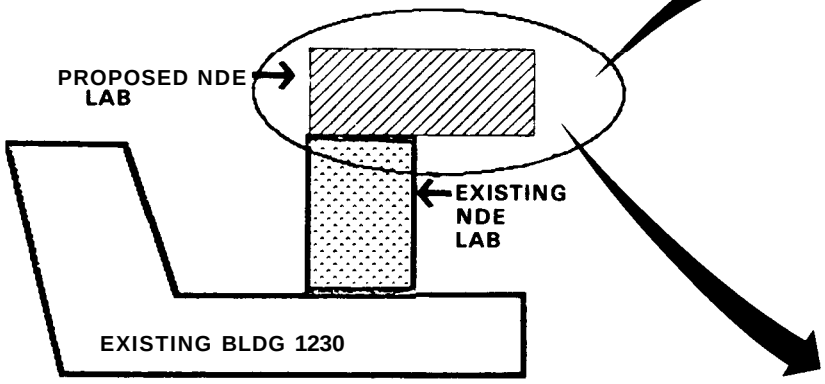
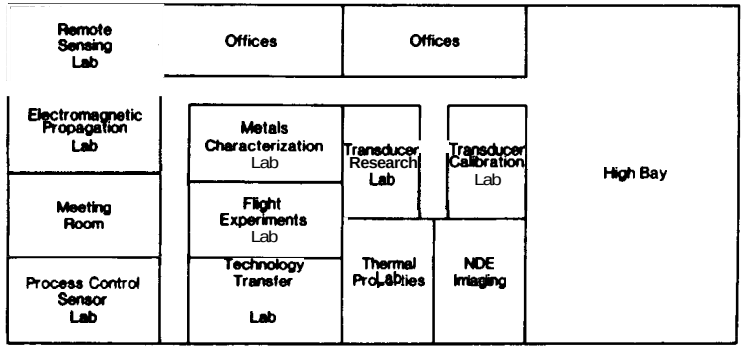


FIGURE 2

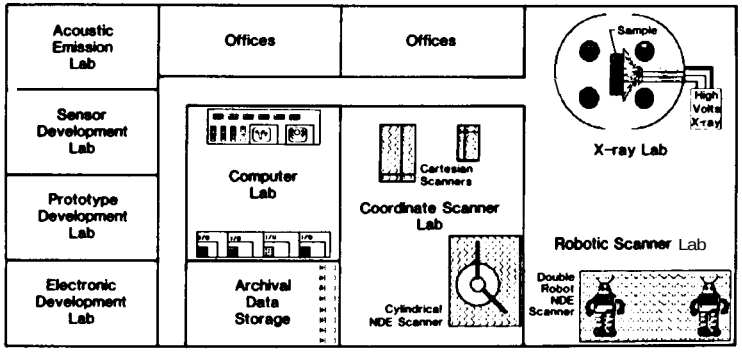
LANGLEY RESEARCH CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF ADDITION FOR, NON-DESTRUCTIVE EVALUATION RESEARCH LABORATORY (1230)

CONCEPT LAYOUT OF PROPOSED ADDITION





SECOND FLOOR OF PROPOSED ADDITION



FIRST FLOOR OF PROPOSED ADDITION

FIGURE 3

VARIOUS
LOCATIONS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

VARIOUS LOCATIONS

Office of Space Tracking and Data Systems:	Amount	Page No.
Construction of the Second Tracking and Data Relay Satellite System Ground Terminal Facility in New Mexico	22 000,000	CF 9-1

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF THE SECOND TRACKING AND DATA RELAY SATELLITE SYSTEM
GROUND TERMINAL FACILITY, NEW MEXICO

LOCATION PLAN

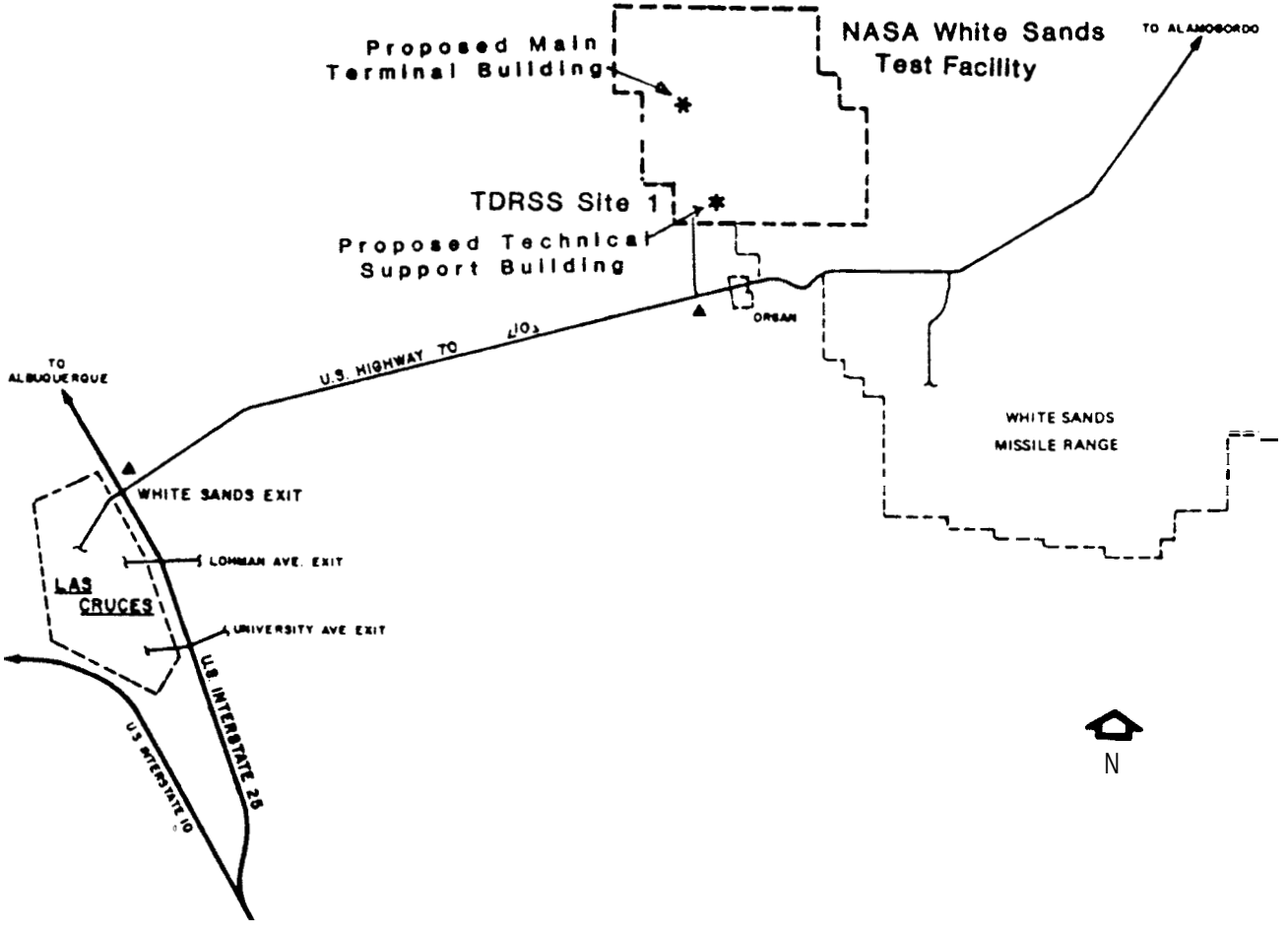


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE: Construction of the Second Tracking and Data Relay Satellite System Ground Terminal Facility in New Mexico

INSTALLATION: White Sands Test Facility, Las Cruces, New Mexico

FY 1987 CoF Estimate: $22,000,000

LOCATION OF PROJECT: Las Cruces, Dona Ana County, New Mexico

COGNIZANT HEADQUARTERS OFFICE: Office Of Space Tracking and Data Systems

FY 1986 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	320,000	---	320,000
Capitalized investment.....	N/A	---	---
Total.....	320,000	---	320,000

SUMMARY PURPOSE AND SCOPE:

This project provides for construction of 118,000-square feet of additional Tracking and Data Relay Satellite System (TDRSS) Space Network ground segment facilities. This new ground terminal will be a backup to the present White Sands Ground Terminal, which is a single node in the control of the Nation's vital space programs. An 84,000-square foot terminal building and a 6,000-square foot power plant will be sited three miles north of the existing ground terminal at NASA's White Sands Test Facility in New Mexico. An associated 28,000-square foot technical support facility will be sited adjacent to the existing terminal.

PROJECT JUSTIFICATION

The present ground terminal for the TDRSS Space Network is the only ground tracking station able to function with TDRSS satellites for supporting the Nation's orbital spacecraft missions. As such, it is a single point of failure in the critical tracking, control, and data acquisition support to these missions. Such failures can include ground terminal hardware and software failures, operational errors, or major failures in the power distribution system, the emergency backup power system, or the air-conditioning systems for equipment and building cooling. Also, a catastrophic event, such as a fire within the ground terminal, could cause an extended ground terminal outage. Experience with the present ground terminal since it became operational in January 1984 has shown that its complexity makes it difficult to operate and maintain. Although significant improvements have been made, longer range plans include major system replacements that will require the present ground terminal to be off-line for extended periods. A backup to the present ground terminal is essential for minimizing the potential loss of critical space assets or data due to a TDRSS ground segment outage from any cause.

Following the 1986 phasedown of the ground based Spaceflight Tracking and Data Network (STDN), the TDRSS Space Network becomes the only lifeline of communications and tracking support for the Space Shuttle and other near-earth orbit spacecraft. This, coupled with the increased frequency of shuttle flights and other critical satellite support required from the Space Network including support for the Hubble Space Telescope, makes continuous TDRSS operational support vitally important. Because loss of communications could endanger astronauts or result in loss of critical mission data, a backup to the present ground terminal is essential. to eliminate the present single point of failure in the TDRSS ground segment. It is also key to sustaining mission support during upgrading of the systems in the present ground terminal.

In addition to being a backup to the present terminal, the second ground terminal will provide the flexibility for supporting additional orbital spacecraft in the space station era through the use of more TDRSS satellites. Each satellite requires a dedicated ground antenna and related electronic system. Although the present ground terminal can communicate with all three TDRSS satellites in the initial Space Network configuration, the system provides for full operational use of only two of the three. The site selected for this second terminal will satisfy the look angles to the east and west locations of present and future TDRSS satellites, and will provide sufficient separation from the present terminal to guard against mutual exposure to catastrophic events or simultaneous communications interruptions from heavy rain. The two terminals are close enough, however, to share key personnel, technical support staff, and general logistic support. In this regard, the technical support facility included in this project will provide logistics and training space for both ground terminals, and will also provide permanent engineering and technical library space for the existing terminal.

IMPACT OF DELAY:

Delay of this project will delay the backup capability needed for the TDRSS ground segment, and continue the present ground terminal as a single point of failure for orbital spacecraft tracking and data support with potential for severe impact of national importance. Construction must begin in FY 1987 for facility availability to install the associated antennas and electronics in 1989.

PROJECT DESCRIPTION:

This project provides the necessary facilities for a complete TDRSS ground terminal at a location on White Sands Test Facility (WSTF) three miles north of the existing ground terminal (Figure 2). Included is an 84,000-square foot Main Terminal Building (Figure 3) for radio frequency equipment and related electronics, equipment and software maintenance, engineering documentation, and related support. Three antenna foundations and a water supply tank will be provided, and a 6,000-square foot emergency power plant will be installed as backup to commercial power. A security fence will surround approximately 40 acres containing the main terminal building, the foundations for three 60-foot diameter antennas, the water tank, and the backup power plant. Also included are the connections to the commercial utilities, a three-mile access road, area paving, grading, and drainage. A 28,000-square foot support building (Figure 5) will also be provided at the site of the existing ground terminal (Figure 4) for technical support logistics and procurement and for personnel offices, training, and guards associated with these ground terminals.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	20,547,000
Roads and paving	LS	---	---	1,780,000
Site work	LS	---	---	2,910,000
Main terminal facility	SF	84,000	121.67	10,220,000
Support building	SF	28,000	105.71	2,960,000
Emergency power plant	SF	6,000	356.17	2,137,000
Special structures	LS	---	---	540,000
Equipment	---	---	---	1,453,000
Emergency generators	LS	---	---	1,453,000
Fallout Shelter (not feasible)	---	---	---	---
Total				22,000,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Main Terminal Building Site Plan
Figure 3 - Main Terminal Building
Figure 4 - Support Building Site Plan
Figure 5 - Support Building

OTHER EQUIPMENT SUMMARY:

Data systems including antennas and related electronic equipment and software will be provided with Spaceflight Control and Data Communication resources in the amount of $300 million during the FY 1987-FY 1991 period.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project.

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF THE SECOND TRACKING AND DATA RELAY SATELLITE SYSTEM
GROUND TERMINAL FACILITY, NEW MEXICO

MAIN TERMINAL BUILDING
SITE PLAN

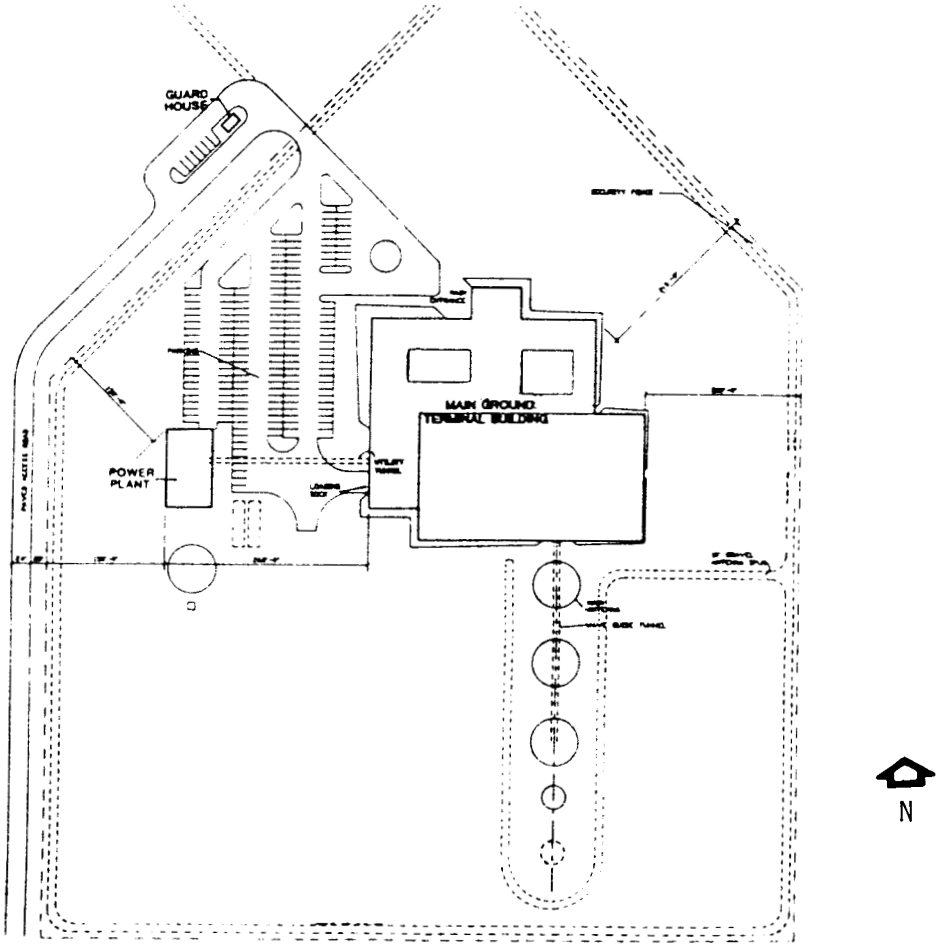


FIGURE 2

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF THE SECOND TRACKING AND DATA RELAY SATELLITE SYSTEM
GROUND TERMINAL FACILITY, NEW MEXICO

MAIN TERMINAL BUILDING

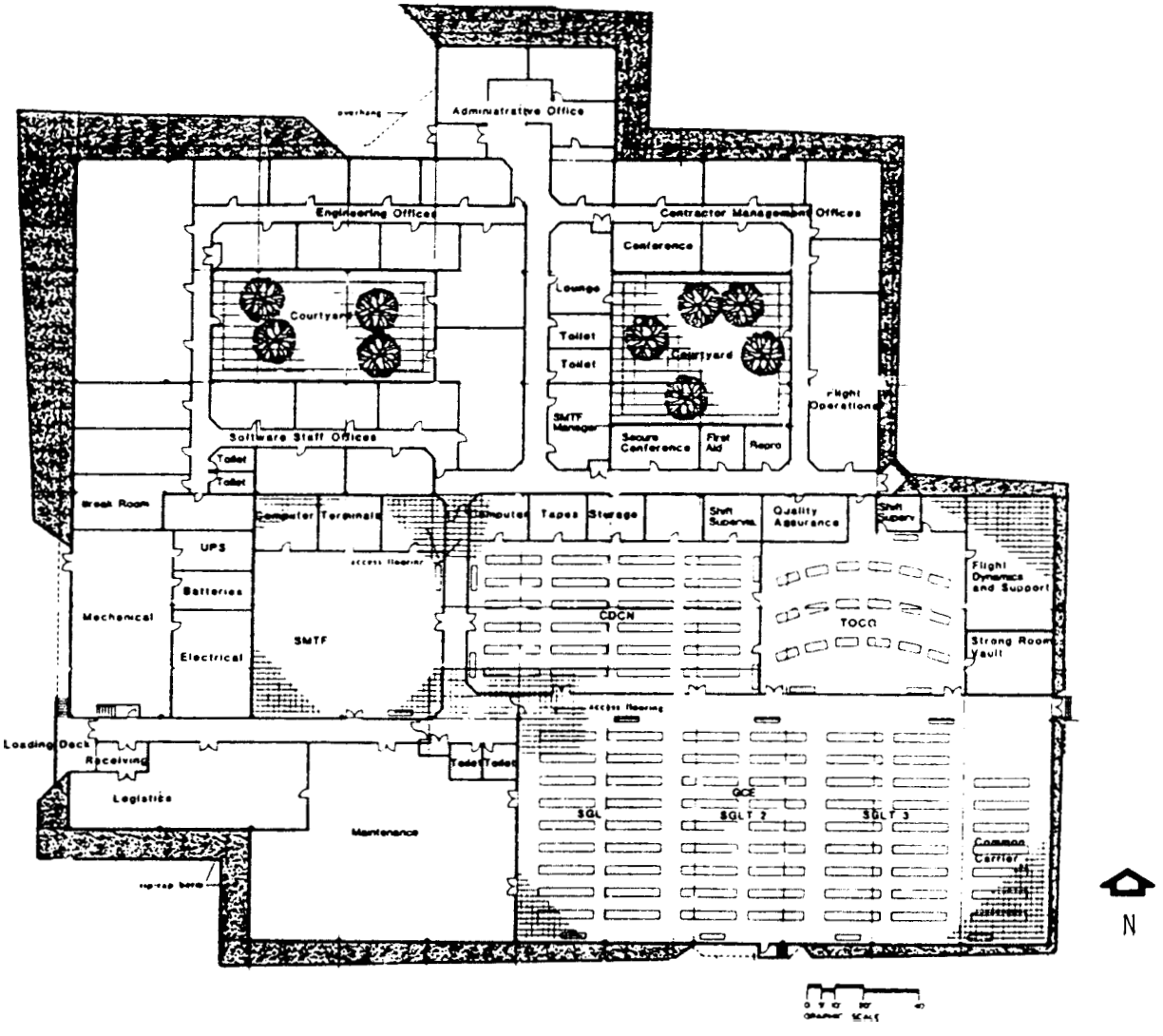


FIGURE 3

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF THE SECOND TRACKING AND DATA RELAY SATELLITE SYSTEM
GROUND TERMINAL FACILITY, NEW MEXICO

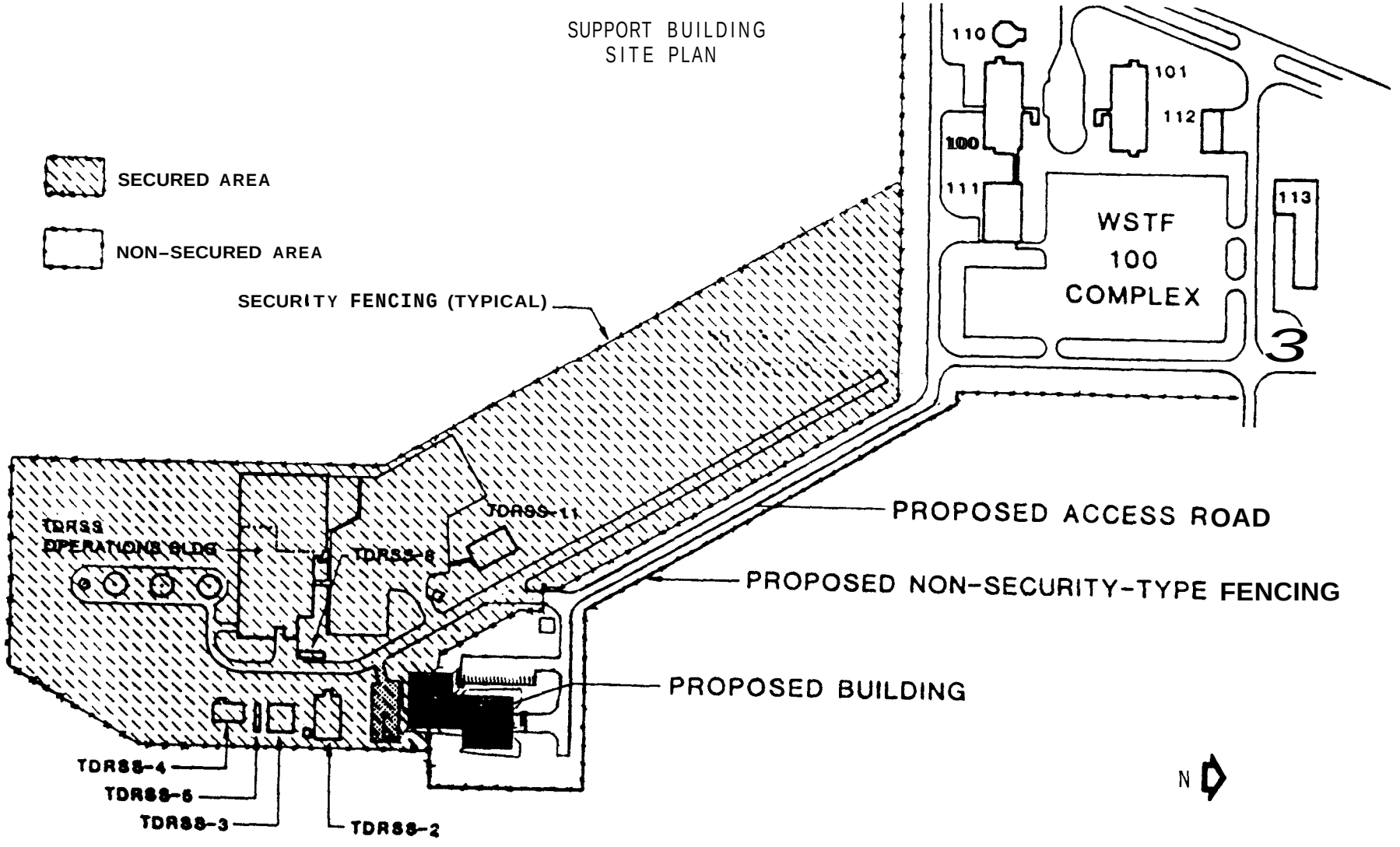


FIGURE 4

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1987 ESTIMATES
CONSTRUCTION OF THE SECOND TRACKING AND DATA RELAY SATELLITE SYSTEM
GROUND TERMINAL FACILITY, NEW MEXICO

SUPPORT BUILDING

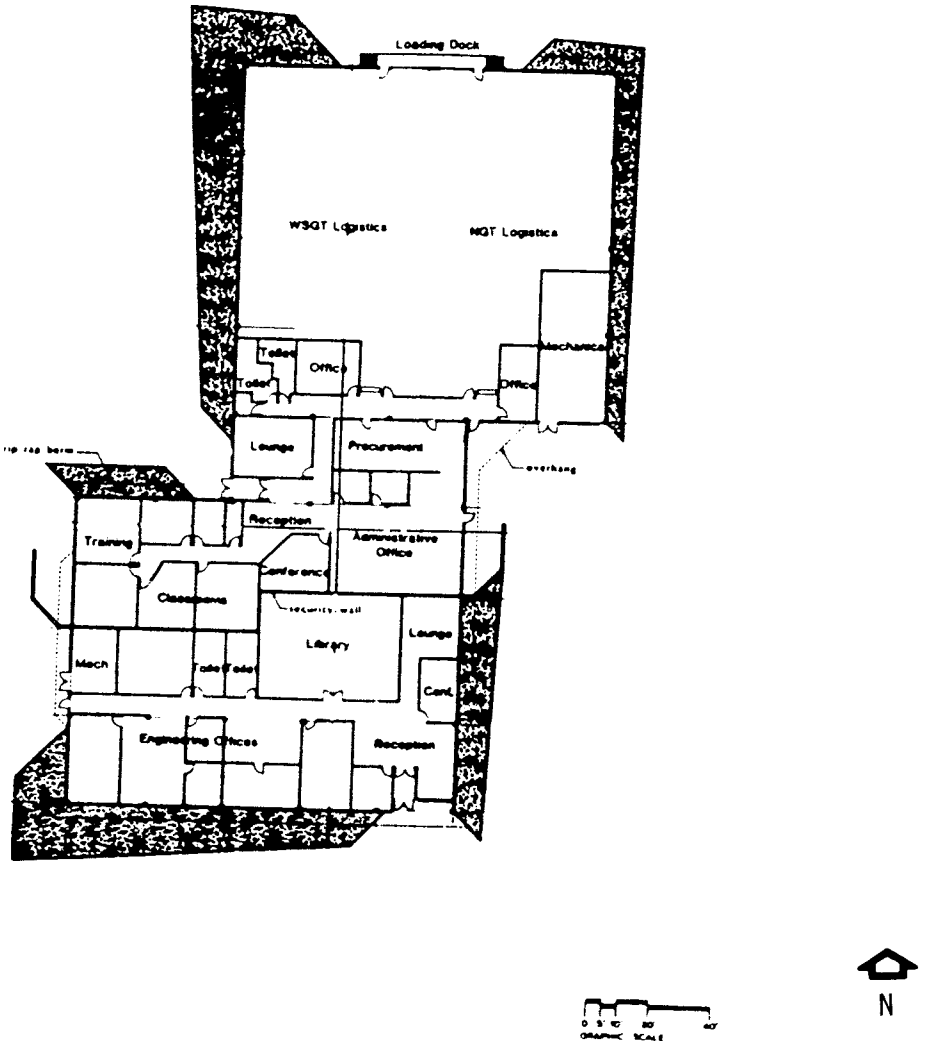


FIGURE 5

REPAIR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

REPAIR

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	2,150,000	CF 10-3
Dryden Flight Research Center	350,000	CF 10-4
Goddard Space Flight Center	2.180. 000	CF 10-5
Jet Propulsion Laboratory	1.030. 000	CF 10-6
Johnson Space Center	2.440. 000	CF 10-7
Kennedy Space Center	3.175. 000	CF 10-9
Langley Research Center	3,030,000	CF 10-11
Lewis Research Center	2.580. 000	CF 10-12
Marshall Space Flight Center	2.570. 000	CF 10-14
Michoud Assembly facility	400. 000	CF 10-15
National Space Technology Laboratories	2.200. 000	CF 10-16
Wallops Flight Facility	1.745. 000	CF 10-17
Miscellaneous Projects Not Exceeding $150. 000 Each	150. 000	CF 10-18
Total	24.000. 000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE:	Repair of Facilities, Not in Excess Of $750,000 Per Project
INSTALLATION:	Various Locations
	FY 1987 CoF ESTIMATE: $24,000,000
FY 1985: $18,000,000	FY 1986: $22,000,000

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for large repairs to facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in the request are those facility repair needs for FY 1987 that can be foreseen at the time of the submission of these estimates, and are not to exceed $750,000 per project. The thrust of this program is to provide a means to restore facilities or components thereof, including collateral equipment, to a condition substantially equivalent to their originally intended and designed capability. The request includes the substantially equivalent replacement of utility systems and collateral equipment necessitated by incipient or actual breakdown. This work also includes major preventive measures which are normally accomplished on a cyclic schedule of greater than 1 year.

PROJECT JUSTIFICATION:

A major portion of the Agency's facilities exceeds 20 years in age, and increases in repair requirements are to be expected. Maintenance and repair costs for mechanical and electrical systems in a typical building are almost three times higher during the 16- to 30-year period of a building's life than they are during the

initial 15 years of beneficial occupancy. At about the 15-year point, many electrical and mechanical components reach the end of their serviceable or economic life and should be replaced in the interest of long-term economy. Continued piecemeal repair of these components usually requires more resources in the long run than replacement after the end of the economic life of the original components. Approximately 75 percent of the physical plant is in the 16- to 30-year old category.

The major thrust of this repair program, as well as the rehabilitation and modification programs, is to preserve the Agency's $3.6 billion (as of September 30, 1985) physical plant. The major distinction between these classes of work is whether or not the intended work is to bring the facility and its components to a condition substantially equivalent to its designed capacity, efficiency, and capabilities. If such is the case, the work is classified as repair. An analysis of each of the projects for which funds are requested indicates that this work must be addressed and progressively accomplished. Otherwise, risks are increased and future costs of the specific work will be greater. More importantly, there will be increased breakdown and costly unscheduled repairs required.

This program includes only facility repair work having an estimated cost not in excess of $750,000 per project. The work is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance and repair activities, or by related routine facility work efforts that are provided for in other than CoF estimates. A repair project, estimated to cost more than $750,000, would be reflected elsewhere as a separate major line item project.

PROJECT DESCRIPTION:

Proposed repair projects for FY 1987 totaling $24,000,000 are described under "PROJECT COST ESTIMATE." Projects estimated to cost not in excess of $150,000 have not been individually described or identified by Center, and the total request for these projects is $150,000. This repair program has been distilled from requests for FY 1987 exceeding $42,000,000, and thus represents a modest request in relation to the continuing backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are of the highest priority. Deferral of this mission-essential work would adversely impact the availability of critical facilities and program schedules.

During the course of the year, it is recognized that some rearrangement of priority may be necessary. This may force a change in some of the items to be accomplished. Any such change, however, will be accomplished within total available repair resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE":

a.	Utility Systems	10,650,000
b.	General Purpose Buildings	1,325,000
c.	Technical Buildings/Structures	6,655,000
d.	Pavements and Drainage	2,710,000
e.	Building Exteriors and Roofs	2,660,000

PROJECT COST ESTIMATE:

A.	Ames Research Center (ARC)	2,150,000
1.	Repair of 11 x 11-Foot Transonic Wind Tunnel	745,000

The tunnel aftercooler coils and fin tube oil heat exchanger are over 25 years old. Both have required excessive repair and down time because of age and corrosion. Tunnel flow quality is degraded due to hot spots caused by sections of the cooling coils being sealed to stop leaks. Contamination of compressor lubricating oil by cooling water causes down time and risks compressor bearing damage. This project will replace about one quarter of the coils in the tunnel aftercooler. It will also replace the fin tube heat exchanger in the oil house with plate type heat exchangers. Automatic controls will insure constant oil temperature during tunnel operation.

2.	Repair of 7 x 10-Foot Wind Tunnels	745,000

These two 45-year old wind tunnels have flat roofs and cross sections. Rain water ponds on the flat top surfaces and on the flat side stiffeners where they connect to the tunnel skin. This frequent water accumulation has created extensive corrosion, which has weakened the tunnel's half-inch steel plate skin and the structural cross bracing. Expansion due to rust has buckled some structural bracing and has opened welded joints. This project will repair or replace buckled structural members, remove corrosion by sandblasting, reweld joints where needed, modify drainage to prevent water accumulation, and provide corrosion resistant painting.

3. Repair of Protective Coatings for Thermo-Physics Facilities..... 380,000

This project provides for cleaning, surface preparation, and corrosion resistant painting of the support structure and major elements of the steam ejector vacuum system (building N-234A), 3.5-Foot Hypersonic Wind Tunnel (N-229), High Reynolds Channels (N-231), and six 75-foot diameter vacuum containment vessels. The exteriors of these structures have not been cleaned and treated in over ten years. Recent inspection has uncovered extensive corrosion caused by salt, air, rain, and fog. Delay in arresting this progressive corrosion will lead to costly future repairs. A break in the structural integrity of the large vacuum spheres would render them useless and require costly emergency repair.

4. Repair of High Pressure Air Compressor Cooling Systems..... 280,000

The C1D Compressor provides about one-half the total high pressure air capacity for Ames Research Center. Pressurization of the air creates large quantities of heat, which is removed by air or water cooled heat exchangers stationed between each of the five stages of compression. The heat exchangers were not new when installed 10 years ago and have required extensive repairs since then. One of these exchangers now has a cracked head and they all require major overhaul. This project provides for rebuilding, replacement, and addition of heat exchangers and associated cooling equipment necessary for continued reliable operation of Compressor C1D.

B. Dryden Flight Research Facility (DFRF)..... 350,000

1. Repair of Roads and Parking..... 350,000

Pavement in the employee parking area is cracked and differential settlement is prevalent. Pavements in the warehousing, shop, and other parking areas have begun to fail due to age and wear. The road to the aircraft apron is severely distressed due to heavy traffic. Continued progressive failure of these pavements will cause deferred repair to be more expensive and will risk foreign object damage to aircraft on the nearby apron. The paving provided by this project will be a 1.5-inch overlay on the parking lot, a 5-inch replacement for the aircraft apron road, and a 1.5-inch or 3-inch overlay, as required, in the warehouse, shop, and other parking areas.

C. Goddard Space Flight Center (GSFC) 2,180,000

1. Repair of Main Breakers, Various Buildings 500,000

This project provides for the replacement of three main breakers and one tie breaker in the Launch Phase Simulator Facility (Building 15) and the Network Test and Training Facility (Building 25) and replacement of 46 feeder circuit breakers in the 120/208 volt switchgear in Building 25. The main breakers and the feeder circuit breakers were installed in the mid-1960's as part of the original building electrical equipment. Due to the worn condition of the spring force retention parts of the main breaker, it can plunge into closed circuit position without manual activation during reset. This sudden closing of the power circuits would create a dangerous condition for the maintenance personnel working on the system. The breaker manufacturer has ceased production of replacement parts because the equipment is obsolete. The replacement of entire breaker units is necessary to insure continued safe and reliable operation.

2. Repair Air-Handling Units in Various Buildings 335,000

This project provides for the repair/replacement of 8 air-handling units (AHU) in the Meteorological Systems Development Laboratory (Building 21) and the NASA Space Science Data Center (Building 26). Also, plenum, ductwork, piping, defective dampers, and automatic temperature control instrumentation panels will be repaired as necessary. The existing package/built-up air handling units have been in operation since the early 1960's. Due to deterioration and corrosion resulting from their long and heavy use, replacement of components or the entire unit has become necessary. The proposed work will improve operational efficiency, reduce maintenance cost, and enhance system reliability.

3. Repair of Roof, Space and Terrestrial Applications Facility 345,000

This project provides for the replacement of 39,000 square feet of roof on the Space and Terrestrial Application Facility (Building 22). Coping, flashing, gravel stop, and other accessories will be replaced as part of the project. The roof is more than 20 years old and contains numerous patches and temporary repairs and is showing signs of general age deterioration. The proposed work will restore facility integrity and reduce the risk of property loss due to water damage.

4. Repair Elevators, in Various Buildngs 280,000

This project provides for the repair and refurbishment of four elevators, one car each in the Space Sciences Laboratories (Building 6), the Applied Sciences Laboratory (Building 11), the Payload Testing

Facility (Building 7), and the NASA Space Science Data Center (Building 26). The repair work includes the refurbishment/replacement of elevator cabs, doors, controls, related equipment, and all worn parts. Provisions for the handicapped and emergency fire access are also included. These passenger/freight elevators have been in constant use since the 1960's for transporting both personnel and equipment. Heavy use, especially from carrying equipment, has caused the elevators to be frequently out of service. This can be for prolonged periods due to the difficultly in obtaining parts for the outdated elevators. This project will restore dependable service and reduce repair and maintenance costs.

5. Repair of Cooling Tower B..... 720,000

This project provides for the repair and replacement of cooling tower equipment including structural framing, basin, decking, fill, water distribution headers, nozzles, drift eliminators, partitions, electrical controls, valves and piping. The installation of flow measuring devices in the tower risers are also included. Cooling Tower B is a 9,000-ton capacity tower and has been in service since 1965. Due to age and deterioration resulting from continuous operation, a complete restoration is required. The tower supports the Central Refrigeration Plant and the chilled water distribution system which are critical elements to successful mission operations at GSFC. The proposed repair work must be implemented to insure chilled water system efficiency and reliability.

D. Jet Propulsion Laboratory (JPL)..... 1,030,000

1. Repair HVAC System, Procurement Office..... 560,000

This project provides for the replacement of six deteriorated and unreliable direct expansion (DX) type HVAC systems in the Procurement Office (Building 190). The existing air handling units are 17 to 24 years old. A new central chilled water system will be provided for both the first and second floors. This new system will supply chilled and hot water to new energy efficient air handling units equipped with economizer cycles. Most of the existing supply and return distribution ductwork is salvageable and will be reused. The existing inadquate restroom ventilation systems will also be replaced. The consolidation of these systems and changing from DX type to chilled water type systems greatly improve the reliability and versatility of this building's HVAC support and also reduce energy and maintenance costs.

2. Repair HVAC System, Combined Engineering Support Building..... 470,000

This project will provide for the repair of the existing HVAC system in the Combined Engineering Support Building (125), including the replacement of deteriorated equipment and improvements to system operations. This building is 33 years old and the original air handlers are rusting, have become unreliable

and are difficult to maintain. The major items of work include: replacement of the air distribution ducts from the three major air handling units to permit more efficient control of air flows; replacement of a multizone air handling unit located in the penthouse equipment room; installation of two roof-mounted units which will be connected to existing ductwork; replacement of two deteriorated hot water boilers; and the modification of the existing chilled water distribution system to a variable flow pumping system. All of the above repairs will result in a more energy efficient, reliable and less costly to maintain HVAC system.

E. Johnson Space Center (JSC)..... 2,440,000

1. Repair of Chillers, Various Buildings..... 250,000

This project provides for the repair of four chillers located in the Central Heating and Cooling Plant, Building 24 and the Emergency Power Building 48. Work includes the replacement of compressor rotary assemblies and various internal components for two chillers in Buiding 24 and two chillers in Building 48. This repair work is necessary to maintain the reliability and efficiency of the chillers which are approximately 24 years old and in need of a major overhaul.

2. Repair Heating, Ventilating, and Air-conditioning Systems, Various Buildings..... 475,000

This project includes the repair and/or replacement of deteriorating air-handler casings and structures, compressors, condensers, etc. Other tasks that will be performed include coil cleaning, damper and duct repair and insulating. the area of concentration will include Buildings 10, 14, 16a, 29, 32, and 49. This project is necessary because aging, high humidity, and salt/chemical content of the air in the JSC area have resulted in a rapid deterioration of these systems beyond the point where routine maintenance can keep them functioning.

3. Repair Electrical Substations, Various Buildings..... 435,000

This project provides for replacement of a 1,000-KVA transformer in Building 33 and the replacement of six 15-kV oil-filled switches, three in Building 5 and one each in Buildings 15, 33 and 44. Three secondary main breakers will also be replaced. The electrical equipment in the substations is approximately 22 years old and the environment has caused them to deteriorate to a point beyond which normal maintenance can keep them operating in a safe manner'. If this equipment is not replaced, substation reliability will degrade and JSC programs could be adversely affected.

4. Repair Deluge Fire Protective System, White Sands Test Facility (WSTF) 265,000

This project provides for repair of the deluge fire protection system at the White Sands Test Facility (WSTF). The water deluge system provides protection in the area 300 and area 400 propulsion test stands and extends to the fuel and oxidizer storage and distribution areas, the chemical steam generator installation, and the alcohol storage tank. Existing carbon steel pipe will be replaced or lined and various valves, manifolds and components will be repaired and/or replaced and serviceable lines will be cleaned. The existing deluge fire protection system was installed in the early 1960's and repair work is now required to return the system to a reliable operating standard.

5. Repair of 15-kV Power Cable, Utility Tunnel System 490,000

This project provides for repair by replacement of electric power feeders 1-6 and 1-8 in the utility tunnel system. The work includes the replacement of approximately 7,000 linear feet of 15kV cable servicing Buildings 4, 5, 7, 7a, 8, 9, 10, 11, 29, 31, 33, 35, and 37. This electrical power cable has been in continuous operation for 20 years. Recently, numerous unscheduled outages have occurred because of faults in the cable system. Examination of the cable indicates that replacement is required to insure electrical power reliability to the critical facilities served by this cable system.

6. Repair of Roofs, Various Buildings 350,000

This project provides large area roof repairs for ten Buildings. The normal aging process, together with various building modifications affecting the roofs, and the presence of numerous roof penetrations have resulted in leaks and moisture accumulations in the existing roofing materials. Approximately 27,000 square feet of roofing on Buildings 9 and 31, and a total of 34,000 square feet of roofing on Buildings 13, 15, 16, 17, 31, 49, 265 and 356 will be replaced. The metal roof sheeting on Building 29 will be coated with a spray foam roof system. This project is needed to preclude damage to the building structure, as well as damage to interior ceiling panels, electrical panels, and sensitive equipment contained in the building.

7. Repair Potable Water Storage Tank..... 175,000

This project provides major repair to the deteriorating one-million gallon, above ground potable water storage tank No. 1. Severe corrosion in the structural framing of the tank will result in eventual structural failure. Repairs include sandblasting the underside of the roof decking, and replacement of existing tank rafters and girders with new structural framing members. The new members and the clean roof underside will be painted. Tank cathodic protection will also be provided.

F. Kennedy Space Center (KSC) 3,175,000

1. Repair O&C Building Substations..... 395,000

This project provides for the refurbishment of the Operations and Checkout Building substations A,B,C,D,E,F,OZ and OY which are over 20 years old and are experiencing corrosion and rapid deterioration due to the harsh environment. Most corrosion is in the base of transformers and switch gear cabinets, which cannot be corrected by routine maintenance. Under this project the substations will be dismantled, structurally restored, painted and reinstalled. Circuit breakers and major connections will be replaced. Without these repairs, there is a high probability of a structural failure or an electrical failure caused by water intrusion with an attendant interruption in STS cargo processing.

2. Repair LCC Firing Room and Vestibule Windows..... 155,000

This project will remove the existing 370 glass panels (4 x 5 feet), replace deteriorated gasket material and glazing sealant and reinstall the panels. The project will also replace approximately 75 cracked glass panels with new 3/4 inch thick laminated glass. These repairs are required because of accrued deterioration caused by weathering conditions. If not repaired, water infiltration will cause damage to the electronic equipment located near the windows.

3. Repair Base Support Building Roof..... 265,000

This project will repair 75,000 square feet of conventional 5-ply built-up roof on the Base Support Building. The work consists of removing all loose gravel, inspection to identify deteriorated conditions, repair blisters, breaks, buckles; then replacing deteriorated felts, repair of base flashing around ventilators, treatment of the entire roof surface with asphalt base resaturant, and replacement of gravel. Failure to provide repair of this deteriorating roof will result in damage to the ceiling, walls and equipment in this building.

4. Repair Communications Office Building Air-conditioning System 490,000

This project will replace the 20-year old air-conditioning system in the Communications Office Building. The new unit will have a nominal rating of 80 tons. New air handlers, compressors, outdoor condensers and modification to the duct system will also be included. The existing system is inefficient, components are unreliable, and replacement parts are difficult to obtain. Repair must be effected now before a major breakdown totally disrupts the communications operations.

5. Replace Water Chillers and Pumps at Flight Crew Support Building 280,000

This project provides for replacement of two existing HVAC water chillers and two chilled water pumps with two new 160-ton water cooled chillers and two 300 gpm chilled water pumps. Associated controls and piping in the Flight Crew Training Building (FCTB) will also be replaced. This project is required due to the unreliability of the existing HVAC equipment used in support of the launch processing system computers in the FCTB. This project will improve reliability and reduce maintenance costs over the life of this equipment.

6. Repair Hangar "AE"..... 470,000

This project provides for general repair of air-conditioning chillers and piping, and replacement of approximately 34,000 square feet of flooring in Hanger "AE", CCAFS. In addition, selected windows, doors, and walls will be refurbished and the fire alarm system modified to meet fire protection standards. This facility includes an important clean room which is used for payload processing. The air-conditioning system and interior of this building has deteriorated beyond correction by normal maintenance and requires general repair to satisfactorily handle the processing of costly payloads.

7. Repair VAB Low Bay Built-up Roof..... 460,000

This project will repair approximately 120,000 square feet of the conventional 5-ply built-up roof system of the VAB low bay. The work required consists of: removal of all loose gravel, inspection to identify deteriorated conditions, repair blisters, breaks, buckles, treatment of entire roof surface areas with asphalt base resaturant and replacement of gravel. Failure to provide repair will result in further deterioration that will damage the ceiling, walls and equipment in this program critical building.

8. Repair NASA Parkway - Kennedy Parkway to Gate #3..... 660,000

This project repairs approximately 7.5 miles of the westbound lanes of NASA Parkway from Kennedy Parkway to Gate %3. Approximately 2,635 tons of asphalt concrete will be required as a leveling course due to settlement of the roadbed. The repair includes a 1-inch asphaltic concrete overlay covering some 105,000 square yards of paving. This road is more than 15 years old and is subjected to heavy traffic which includes cars and buses that transport the heavy visitor load (approximately 2,000,000 per year). The roadbed and surface deterioration is accelerating and higher repair costs will be incurred if these repairs are deferred.

G. Langley Research Center (LaRC) 3,030,000

1. Repairs to High Pressure Systems, Hypersonic Blowdown Tunnels..... 550,000

This project provides for repairs to high pressure systems in the Hypersonic Blowdown Tunnels. The work includes: replacement of defective piping, valves and fittings, and inspection/repair of defective welds. These systems have been analyzed and inspected as part of LaRC's on-going recertification program and have been determined to be defective and potentially unsafe. This project will restore these systems to within safe operational parameters.

2. Repair of Roof Building 1202. 550,000

This project will replace approximately 57,000 square feet of existing built-up roofing at Building 1202. Repairs will include removing all existing roof material, providing new insulation, flashing, and all other materials necessary to restore the roof to its original condition. Severe roof leaks continue to occur due to rapid deterioration caused from expansion of water vapor trapped between existing roof layers. Normal maintenance is no longer a viable option.

3. Repairs to 30 X 60-Foot Tunnel..... 730,000

This project provides for the replacement of obsolete circuit breakers in the 30 X 60-foot tunnel main drive switchgear and for the replacement of approximately 40,000 square feet of roof at the north end of the building. The switchgear work requires removing the existing breakers, installing new circuit breakers, and reconnecting cables. The circuit breakers are no longer commercially available, therefore any failure means lengthy downtime until replacement parts can be custom made. The existing corrugated asbestos roof will be replaced with a metal roof, drains located in the roof valley will be enlarged, and other related repairs will be made. The roof was installed in 1931 and has become brittle with age causing many water seals to break. Normal maintenance can no longer keep it from leaking.

4. Repairs to High Pressure Systems 450,000

This project provides for repairs to the high pressure air, nitrogen and helium systems in the High Speed Aerodynamics Complex at Langley Research Center. The work to be done under this project includes: replacement of defective piping, valves and fittings, inspection of welds, and repair of defective welds. These systems have been determined to need repair under LaRC's on-going pressure system recertification program. Much of the piping, valves, and welds do not meet applicable codes and center safety criteria and must be repaired for continued safe operation.

5. Repair Electrical Switchgear, Various Facilities..... 510,000

This project provides for the replacement of switchgear "C" in Building 1220, switchgear "B" in Building 1201, switchgear "A" in Building 1205, and a day panel (cubical No. 1) in Building 1230. The work requires disconnecting cables feeding existing loads, removing the panels to be replaced, installing new panels, and reconnecting the existing cables. The switchgear to be replaced under this project contains circuit breakers which are no longer manufactured. Procurement of spare parts is very difficult and they can only be obtained after very long delivery periods. New circuit breakers will eliminate the risk of extensive downtime and insure a safer and more reliable protection system.

6. Repair Cooling Towers, Various Locations..... 240,000

This project provides for the replacement of cooling towers at Buildings 1212, 1146, 1148, and 1230. The cooling towers range in capacity from 150 GPM to 1200 GPM. The work to be accomplished will include demolishing the existing cooling towers, replacing or modifying the basins, piping and electrical services as required, and installing new tower structures. These cooling towers are very old and in very bad condition. Maintenance has become costly and ineffective. Replacement is essential to ensure un nterrupted service to the facilities.

H. Lewis Research Center (LeRC)..... 2,580,000

1. Repair Process System for Recertification..... 335,000

This project provides for the repair to the 45 PSIG combustion air system piping by replacing and repairing various piping components that do not comply with current pipe and pressure vessel codes. The work includes replacement of three 20-inch relief valves, replacement of ten aftercooler pipe bundles and replacement of thirty pipe supports. This project is part of a planned program to ensure safe operation of pressurized systems at the Lewis Research Center. The system in this project supports approximately 15 research facilities and is more than 30 years old. The repairs are needed to maintain structural integrity and system reliability in support of vital aeronautical research activities.

2. Repair Domestic Water Systems, Various Buildings..... 415,000

This project provides for the separation of domestic and nondomestic water distribution systems in various portions of the LeRC potable water distribution system including Buildings 3, 4, 9, 14, 24, 50, 77 and 102. The work includes the removal of the existing domestic water system; installation of new pipes, valves, fittings and insulation; installation of backflow prevention devices and removal of asbestos insulation. This

project is part of a planned program to upgrade the domestic water system and remove the hazards created by cross connections between domestic/non-domestic systems and the possibility of backsiphoning.

3. Repair of Air Dryer Bed, 8 x 6-Foot Supersonic Wind Tunnel (SWT)..... 695,000

This project provides for repairs to the air dryer bed at the 8 x 6-foot SWT, Building 57. Air dryer beds are required to preclude excessive moisture from entering the tunnel air flow and disrupting test conditions. The work in this project includes removal and reinstalling the desiccant; installation of new desiccant screens and repairs to the structural supports. Deterioration of the support screens have adversely impacted the testing capability of the tunnel and failure of the dryer beds are causing frequent testing delay. This project will provide repairs to the deteriorated dryer beds to prevent further disruptions to the tunnel operations.

4. Repair of Air Systems, Engine Research Building..... 635,000

This project provides for repairs to the process and combustion air systems in the Engine Research Building 5. The work includes replacement of deteriorated isolated valves/actuators in the process air system and repair/modifications to the 24-inch combustion air line. The valves, actuators, and piping in these air systems are over 30 years old and have required constant maintenance. Despite the maintenance efforts, these systems no longer function adequately, are a potential safety hazard, and have a negative impact on research test results. Replacement of these valves and repair to these systems are necessary to ensure the safety of personnel/equipment and to maintain operational efficiency.

5. Repair of Roof, Fabrication Building..... 290,000

This project consists of the repair of approximately 47,000 square feet of roof on the Fabrication Building 50. The work includes the removal of all roofing material and penetrations. Existing roof penetrations will be reconstructed to current standards. Obsolete roof equipment out of service and no longer needed will be removed. A Class A fire underwriters approved roofing system will be installed with the necessary roof insulation to meet current ASHRE standards. Roof surfaces in pedestrian traffic areas will be protected with roof walkways. These 20-year old roofs, despite periodic routine maintenance, have deteriorated to the point where extensive repair is required to prevent damage to the building structure and equipment therein.

6. Repair of Main Water Distribution System, Plum Brook..... 210,000

This project will repair portions of the main water distribution system at the Plum Brook Station. The work in this project includes the repair of raw water supply lines, the replacement of the raw water diesel booster pump, the modification and extension of the domestic water system to the Engineering Building, and the repair or replacement of shut-off valves and hydrants. The water distribution components being repaired are major elements of the Plum Brook water and fire protection systems. The systems are approximately 45 years old and are in need of significant repair. This project will allow the water distribution system to continue to operate in a safe and reliable manner and will insure the health and fire protection integrity of the Plum Brook Station.

I. Marshall Space Flight Center (MSFC)..... 2,570,000

1. Repair Pressure Vessels, Increment II..... 710,000

This project provides for repair of high pressure vessel defects identified during a safety survey of the pressure systems. Two large 6,000 cubic foot compressed air vessels (one 400 psi and the other 125 psi) and eighteen 35-cubic foot high pressure air vessels (3500 psi to 5000 psi) will be repaired. These pressure vessels store a large volume of high pressure air that support test programs. It is essential that the structural integrity of these vessels be maintained. Loss of this air storage capacity would impact all major test programs at MSFC.

2. Repair High Pressure Piping..... 700,000

This project provides for the replacement of 25- to 30-year old high pressure piping systems. Work includes the replacement of approximately 5,000 linear feet of 3-inch gaseous nitrogen (GN_2) pipe lines connecting the generation plant to the East Test area. Also included is the replacement of the GN_2 manifold at bottle battery 4598 and related work. This manifold connects eleven 5,000 psi storage vessels which serve the East Test area. This project is part of a plan to repair deteriorating pipeline systems which support vital laboratory and testing activities at the center. This effort will eliminate potential hazards due to corrosion and possible leakage that can occur adjacent to inhabited buildings. These 25- to 30-year old systems are exceeding their design life and increasing failure rates are being experienced.

3. Repair Roofs, Various Buildings..... 485,000

This project provides for repairing approximately 3,800 squares of roofing for various Buildings including 4249, 4670, and 4752 at MSFC. Work includes installation of new roof systems with insulation,

flashing, expansion covers, control joints, gravel guards, and pitch pockets over existing roof decks. Also included will be the rehabilitation of vents and hatches, roof deck repairs, and recoating existing roofs of several buildings. Spot repairs are no longer effective nor economical. Some roofs are weathered, dried out, and have soft spots where insulation is saturated. To alleviate these problems, and to preserve the structures, these roofs must be repaired.

4. Repair HVAC Systems, Various Buildings 420,000

This project is part of a planned program to repair major HVAC equipment in Buildings 4494, 4654, 4659, 4670, and 4674. This work includes the repair or replacement of chillers, cooling towers, and air-handling units. Also included is the replacement of direct expansion air-conditioning units, pumps, compressors, and other related work in several buildings. The HVAC equipment is in a deteriorated condition and requires continual maintenance to keep it operable. It is more economical to replace major items of HVAC equipment than to continue repairs. These facilities are essential to the operations at the center and the repair of these HVAC systems is urgently needed at this time.

5. Repair Exterior, Various Buildings 255,000

This project provides for the exterior repair of approximately 350,000 square feet of building wall and surfaces for various buildings. Work includes surface preparation and application of a protective coating, repair or replacement of gutters, downspouts, windows, doors, and related work. Exterior repair is required to protect these buildings from the cumulative damaging effects of deterioration and will preserve these facilities for continued operation. The installation of new exterior siding with insulation will reduce energy consumption, maintenance, and short term repair efforts.

J. Michoud Assembly Facility (MAF) 400,000

1. Repair Barge Dock 400,000

This project provides for repairs to the MAF Barge Dock, where the External Tanks are loaded on to barges and shipped to the launch sites. The work consists of structural restoration of the east and west docks; rehabilitation of electrical service; dock surface pavement repairs; and new lighting. Structural restoration includes timber and fender replacement. The Barge Dock area is too deteriorated for effective corrective maintenance and requires a complete repair. This project will restore the operational reliability of the barge dock area, and reduce recurring maintenance costs.

K. National Space Technology Laboratories (NSTL) 2,200,000

1. Repair of Complex B-2 Water Chilling System 700,000

This project provides for replacing two existing high temperature hot water absorption chillers (175 tons each) in the B-2 complex test control center, Building 4210, with one electrically driven centrifugal water chiller (250-ton). The pumping system will be interconnected to a chiller located in the Data Acquisition Facility, Building 4995 to provide emergency backup and peak load performance. The absorption units have been in continuous use for approximately 20 years. Similar units in other buildings have failed in the past 4 years because of deterioration. Replacement of the units now will preclude a major failure and provide the most energy efficient operation at the lowest life cycle cost while maintaining essential service to these mission critical facilities.

2. Repair 13.8 kV Submarine Cable 490,000

This project replaces six of ten 13.8 kV submarine cable crossings in the main canal. All electrical power is supplied to NSTL through six (6) individual 13.8 kV circuits. The existing ten cable crossings were installed in the mid-1960's and have exceeded their life expectancy. At this time, only six of the ten original cables are in service because of deterioration and failures to the cable system. With this serious deterioration to the in-service cables, and no spare cable capacity, any failure would result in a lengthy outage which could adversely affect SSME test operation. To assure continuity of electric service to NSTL, it is mandatory that reliable canal cable crossings be made available.

3. Repair Primary Roads 500,000

This project provides for 52,500 square yards of a 1-1/2 inch bituminous overlay on the north and southbound lanes of Road "A" from the south gate of the Mississippi Army Ammunition Plant to two miles south. This road, which is the main artery for access to NSTL, is rapidly deteriorating with numerous cracks and dips indicating subsurface breakdown and checkering and shoulder deterioration. A traffic signal will also be installed at the intersection of Roads A and J to improve traffic flow patterns. In addition, two low sections of the lower Gainville Road will be elevated to eliminate annual spring flooding which has reached up to six feet in depth.

4. Repair of Heating, Ventilating, and Air-conditioning Components, Various Buildings 280,000

This project provides for the repair to the heating and cooling equipment in various buildings. The work includes replacement of the split system heat pumps and air-conditioning units in seven (7) buildings and

the replacement of rotating equipment on packaged chillers in seven (7) other buildings. Replacement of associated control and ancillary equipment will also be provided. These buildings house the Administrative, Engineering, Research and Development and Support activities at NSTL. The HVAC units have been in continuous use for more than 20 years and require continuous maintenance. These units have exceeded their expected service life, of 15 years for split system heat pumps and air-conditioning units, and 20 years for water chillers. Replacement of these units 'is a cost effective way to reduce maintenance costs, preclude major system failures, and provide a reliable HVAC system.

5. Repair of Chiller Unit Building 4995 230,000

This project provides for the replacement of a 315-ton absorption chiller with an electrically driven 200-ton chiller unit at the Data Acquisition Facility, Building 4995. Modifications will include the installation of circulating pumps, and the addition of electrical services to accommodate the new electrically driven equipment. The absorption chiller has been in continuous use for more than 20 years and has had significant repairs to maintain satisfactory operating condition. Replacement of the absorption units with electrically driven units will provide an energy efficient and more cost-effective system.

L. Wallops Flight Facility (WFF) 1,745,000

1. Repair Runway 4/22 Test Section Pavement 725,000

This project provides for the repair of Runway 4/22 at the Wallops Flight Facility. This runway is fully instrumented for aeronautic research and has special landing surfaces including transverse grooved areas and a flat section which allows a pool of water to be created for anti-skid research. These special features have hastened the deterioration, and repairs are mandatory to ensure continued safe runway research and operations. This project provides for the resurfacing of approximately 750,000 square feet of surface and the milling and refilling of deep cracks caused by water seepage. In addition, the special grooving required for the research must be redone. These repairs are required at this time for continuing anti-skid research.

2. Repair Paved Surfaces at the National Scientific Balloon Facility Palestine, Texas 300,000

This project provides for the resurfacing and repair of the balloon launch pad area, roadways and parking lots. These areas include approximately 100,000 square feet of surface. One-half of this area will require overlay seal coat. The launch pad at NSBF is the active balloon launch area. Its surface is eroded by the launch process and requires repair and resurfacing at 5-year intervals (last done 1982). The roadways, which are primarily used for payload and balloon transportation and secondarily for personnel transportation,

have deteriorated. They must be maintained to provide transportation to and from the launch area. The parking lots are also in a poor state of repair. The majority of these surfaces are part of the original construction of NSBF and are approximately 20 years old.

3. Repair Island Causeway Road.. 250,000

The 25-year old causeway road which connects the WFF mainland with the island has not been repaired or resurfaced in 20 years. This project consists of the repair of existing pavement deficiencies, including cracking, settlement, and heaving, and the resurfacing of 2 miles of causeway (20 feet wide) with a base coarse and surface coarse. The resurfacing is necessary due to environmental deterioration which has embrittled the bitumen pavement, and cracking and settlement that is the result of years of use.

4. Repair Island Sewage Ejector Stations..... 245,000

This project calls for the replacement of five sewage ejector systems located at the north and south ends of Wallops Island. They function as the intermediary system between the gravity collection system and the sewage treatment lagoons. The present 20 year old ejector systems function poorly and require excessive maintenance. Due to the age of the system, parts are not readily available and require long lead times for delivery. Procurement of electric ejector systems will increase efficiency, decrease maintenance costs and man-hours, and provide the necessary capability for environmentally safe sewage disposal.

5. Repair Buildings at the National Scientific Balloon Facility
Palestine, Texas... 225,000

This project provides for the replacement of 31,500 square feet of roof on the Operations Building and the roof and metal side panels on the STRATOPORT I Building. Associated accessories and flashings will be replaced as part of this project. Both buildings are 21 years old and the roofs are showing signs of general deterioration. The metal side panels on the STRATOPORT I Building are of the same age and have experienced similiar deterioration. The proposed work will restore facility integrity and minimize potential property loss due to water damage.

MISCELLANEOUS PROJECTS LESS THAN $150,000 EACH 150,000

Total 24,000,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated **25,000,000** to 30,000,000 per year will be required for the continuation of this essential repair program.

REHABILITATION
AND MODIFICATION
OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

REHABILITATION AND MODIFICATION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	1.795. 000	CF 11-3
Dryden Flight Research Center	1.195. 000	CF 11-3
Goddard Space Flight Center	2.110. 000	CF 11-4
Jet Propulsion Laboratory	2.070. 000	CF 11-6
Johnson Space Center	3.865. 000	CF 11-7
Kennedy Space Center	3.035. 000	CF 11-9
Langley Research Center	2.895. 000	CF 11-11
Lewis Research Center	2,970,000	CF 11-13
Marshall Space Flight Center	3.840. 000	CF 11-14
Michoud Assembly Facility	2.010. 000	CF 11-16
National Space Technology Laboratories	1.440. 000	CF 11-18
Wallops Flight Facility	1.430. 000	CF 11-18
Various Locations	665. 000	CF 11-20
Miscellaneous Projects Not Exceeding $150,000 Each	680. 000	CF 11-20
Total	30.000. 000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE:	Rehabilitation and Modification of Facilities, Not In Excess of $750,000 Per Project
INSTALLATION:	Various Locations
	FY 1987 CoF ESTIMATE: $30,000,000
FY 1985: $22,000,000	FY 1986: $26,000,000

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for the rehabilitation and modification of facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in this request are those facility rehabilitation and modification needs for FY 1987 that have been fully identified at the time of the submission of these estimates, and are estimated not to exceed $750,000 per project. The purpose of this program is to restore or enhance the condition of a facility so that it can more effectively accomplish its designated purpose or increase its functional capability.

PROJECT JUSTIFICATION:

Based on the initial investment costs, the NASA Capital Type Property totals approximately $7.2 billion (September 30, 1985), of which the physical plant comprises some $3.6 billion. A continuing program of rehabilitation and modification of these facilities is required to:

a. Protect the capital investment in these facilities by minimizing the cumulative effects of wear and deterioration.

b. Ensure that these facilities are continuously available and that they operate at peak efficiency.

c. Improve the capabilities and usefulness of these facilities and thereby mitigate the effects of obsolescence.

d. Provide a better and safer environment for all personnel.

This program includes only facility rehabilitation and modification work having an estimated cost not in excess of $750,000. The work is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance or by related routine facility work efforts that are provided for in other than CoF estimates.

PROJECT DESCRIPTION:

Proposed rehabilitation and modification projects for FY 1987 totaling $30,000,000 are described under "PROJECT COST ESTIMATE." The total program of $30,000,000 has been distilled from requests of approximately $54,000,000 and represents only a modest request in relation to the backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are the highest priority requirements. Deferral of this mission-essential work would adversely impact the availability of critical facilities, program schedules, and energy conservation objectives. Only those projects estimated to cost less than $150,000 have not been individually described or identified by Center. The total cost of these miscellaneous projects is $680,000.

During the course of the year, some rearrangement of priorities may be necessary. This may force a change in some of the items to be accomplished. Any such change will be accomplished within available resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE:"

a.	Utility Systems	5,300,000
b.	Fire Detection/Protection Systems	2,475,000
c.	General Purpose Buildings	3,005,000
d.	Technical Buildings/Structures	17,275,000
e.	Pavements and Drainage	1,945,000

A. Ames Research Center (ARC) 1,795,000

1. Rehabilitation and Modification of High Pressure Air Distribution System 745,000

The high pressure air distribution system was installed over 25 years ago and serves all major Ames research facilities. During subsequent years piecemeal additions were made resulting in a system that has no central monitoring and control station and no control and monitoring devices within individual using areas. This project will provide necessary piping, valves, and control and monitoring electronics to connect four major high pressure air users to the central station. Valves and piping will be upgraded and new instrumentation and controls will be provided. This project is part of a multi-year program to modify the high pressure air system and upgrade it to a safe and reliable operating system.

2. Modifications to Various Buildings for Safety.. 430,000

This project is part of an ongoing effort to correct fire and personnel safety deficiencies in old buildings that were built using outdated safety codes or in which the use has changed significantly so that old safety code applications must be reassessed. Modifications to seven buildings will include fire resistant exit enclosures, additional fire exit doors and signs, electrically activated fire rated doors at stairwells, fire alarm pull boxes, fire dampers in existing ducts, and upgrading of some electrical work to meet hazardous area requirements. The buildings involved are N-211, N-213, N-237, N-239, N-240, N-240A, N-243, and N-244.

3. Modification of Aerodynamic Heating Facility (N238) 620,000

This project will provide a new radiative heating system at the Interaction Heating Facility that will interface with the existing 60-MW ARC-jet. The combined facilities will provide radiative and convective heating necessary for simulation of high speed, high altitude flight in testing thermal protection systems. This testing will be required for the aero-assisted orbital transfer vehicle and other future hypersonic vehicles. Radiative heating will be provided by two 32 MW xenon arc lamp solar simulators with a variable flux level of 10 to 35 watts per square centimeter on a 12.7 centimeter (5 inch) diameter target. The project includes necessary power, control, cooling, and optical support equipment.

B. Dryden Flight Research Facility (DFRF) 1,195,000

1. Rehabilitation and Modification of Communications Ducts 460,000

Existing communications ducts require rehabilitation because of deterioration caused by flooding, water seepage, and cave-ins. Most ducts are damaged or full of cables and cannot accept new cable runs.

Communications cabling is required for new programs and facilities. With the existing ducts in the present state of disrepair, new cable runs would require costly new duct banks to be installed. This project will modify, replace, or upgrade communications ducts between buildings, and where practical, consolidate cables in existing ducts. This will free space for future cable at a much lower cost than installing new duct banks.

2. Modifications for Aeronautical Test Range Security..... 735,000

Present and future flight test programs require processing classified data and securing classified documents. At present, the Dryden Western Aeronautical Tracking Range data processing equipment and procedures fail to meet classified criteria for either physical or electronic security. This project will allow NASA to meet minimum security criteria for the computer area used to process test range data. It is necessary for NASA to access this classified data so that technical information can be transferred for NASA research. The security improvements will include, but not be limited to, red/black power cable separation and filtration, computer access intrusion alarm system, physical security of door, window, and other perimeter penetrations, and improved grounding.

C. Goddard Space Flight Center (GSFC)..... 2,110,000

1. Modification of Smoke Detection System in Data Interpretation Building 490,000

This project provides for the replacement of the 20-year old, obsolete smoke detection system for Building 23. Work will include the replacement of the non-zoned smoke detection system with a zoned annunciation system, including new smoke detector heads and new signal wiring. The new system will guide fire fighters to the location of a fire within the building. This new system is essential to upgrade the level of fire protection in this building to within present code standards.

2. Modification of Optical Facilities in the Instrument Construction and Installation Laboratory 400,000

This project provides for the modification and expansion of the optical facilities in the Instrument Construction and Installation Laboratory, Building 5, to accommodate fabrication and testing of up to 200 optical system components per year. Work will include enlargement of the Optical Grinding Laboratory to house two new grinding machines, support modification of controls for existing machines and improve facility safety. In addition, a high bay area will be converted to an Optical Micro Finishing Laboratory to house new sophisticated optical fabricating and testing equipment, relocated and modified optical polishing equipment, mechanical and electrical support space and storage. Additional space will be modified to provide a staging

and technical support area for the remainder of the laboratory. This project is necessary to provide for increases in the CSFC optical manufacturing capability in support of a growing number of Shuttle borne instruments such as SPARTAN experiments and advanced optical systems for free fliers in the explorer series.

3. Modifications for Laser Inter-Satellite Communications Facility in the Frequency Standard and Test Facility 200,000

This project provides for conversion of the Laser Ranging Facility into a conventional class 10,000 clean room with temperature and humidity control, and two small building additions to house a change room and mechanical and electrical support equipment. These facility modifications are required to permit the installation of two multi-axis test tables which simulate spacecraft dynamics. These test tables are essential to "full-up" systems level tests of laser inter-satellite communication systems. They will permit testing/evaluating data acquisition, tracking and pointing of communications systems. The facility and equipment modifications are necessary to support Space Station and free flyer programs.

4. Modification of Uninterruptible Power Supply (UPS) System in the Administrative Support Building 350,000

The Computer Services Branch (CSB) provides payroll, NASA Equipment Management System (NEMS), and accounting support for the Center. Due to continual growth of the centerwide administrative automated data processing operations, only a limited amount of the essential electronic equipment is protected by the existing UPS. An upgraded system is required to provide comprehensive back-up. This project will provide a 150 KVA UPS System, additional wiring and ventilation system to support the CSB computers, construction of an addition to house the new UPS, and the installation of additional cooling capacity for the projected increase in automated data processing equipment (ADPE). The proposed UPS room addition will also solve the long standing noise probletn caused by the existing UPS being located in the core of the building.

5. Rehabilitate Thermal Test Chambers in the Payload Testing Facility 385,000

This project provides for the replacement of thermal shrouds and thermal control systems in two thermal-vacuum facilities. Work includes the removal of the cryogenic thermal shrouds and thermal control systems from two 3 feet in diameter by 3 feet in length thermal-vacuum test chambers and installation of new cryogenic thermal shrouds and new thermal control systems. These chambers are "workhorses" used for testing subsystems in the development and qualification of instruments as flight hardware. The thermal shrouds in both facilities are made of copper and during the 20 plus years of use have accumulated over 1,200 thermal cycles which has caused increased fatigue cracks and shroud leaks. These cracks and leaks cause freon to come

in contact with experiments being tested in the chamber. Experiments such as GRO/EGRET cannot tolerate exposure to this compound. It is therefore necessary to correct this situation and improve the operation of these chambers.

6. Rehabilitation and Modification of the Central Heating and Refrigeration Plant..... 285,000

This project provides for the rehabilitation of the architectural, electrical and mechanical systems in Building 24. The work includes the replacement of five end-of-life boiler stacks, refurbishment of one and installation of two sound proof control booths, increasing the load bearing capacity of the steel plate floor in the south chiller room, improving access to the emergency generation room, repair of the bridge crane controls, and miscellaneous required repairs and modifications to the building exterior and other minor systems. The proposed work is required to improve the health and safety conditions in and around the plant and to restore the overall operating efficiency of the aging plant.

D. Jet Propulsion Laboratory (JPL)..... 2,070,000

1. Modifications for Chemical Research and Instrument Analysis Laboratory..... 740,000

This project provides for the modifications to the seventh floor of the Physical Sciences Laboratory, Building 183, to house a 7,000-square foot chemical research and instrument analysis laboratory. The existing chemistry facilities are located in three very old and obsolete buildings which are substandard, overcrowded, unsafe, and scheduled for demolition in the near future. The new laboratory will be used to conduct chemistry research, accommodate analytical instrumentation, and provide safe laboratory space. The laboratory is necessary for research in such areas as lithium batteries, alkali metal thermoelectric conversion, molecular electronic processes and advanced dielectric materials. The work will include fume and/or horizontal air flow exhaust hoods, wet sinks, precise temperature controlled laboratories, and ventilated storage areas for flammable chemicals. Safety equipment will include emergency showers and eye fountains. Natural gas, water, compressed air, vacuum and gaseous nitrogen supplies will be installed.

2. Modification for Pneumatics, Clean Assembly and Test Laboratories..... 285,000

This project provides for the modification of 5,280 square feet of Building 233 to support the development assembly and testing of various pneumatic valves and controls. Currently this function is performed in Building 113 which is scheduled for demolition in 1987. The southeast quadrant of the first floor of Building 233 will be renovated to support the required testing equipment, and an existing clean room will be modified as required. Building 113 was originally constructed 35 years ago and has become crowded, inefficient and very costly to maintain. The present pneumatic shop conducts high pressure test operations

behind barricades located under a corugated metal roof. The clean room portion of Building 113 is over 233 years old and the poor design makes it inadequate for the present use. Moving this function *to* Building 233 will correct the crowded, unsafe and inadequate conditions that are prevalent in the existing shop area.

3. Modify Pioneer, Surveyor and Corporal Roads..... 700,000

This project will modify Pioneer, Surveyor and Corporal Roads by realignment, construction to proper widths, and reduction of existing grades. Also included will be installation of street lights, retaining walls, and landscaping; as well as the demolition of a small 30 year old building (53), and relocation of a small heating plant. These roads are main vehicular arteries in the north lab area of JPL. The easterly 1,240-linear foot portion of Pioneer Road is difficult to traverse due to sharp turns. abrupt steep grades, and a 12-foot wide constriction near Building 148. The existing paving is cracked and overdue for replacement. The 400-linear foot segment of Surveyor Road is also in a poor state of repair, has a sharp 180° curve combined with a steep grade which renders this stretch of road very difficult and unsafe to negotiate. A 400-linear foot stretch of Corporal Road has a hazardous hairpin bend around Building 188. This project will correct these unsafe conditions and provide proper access to the north areas of the Laboratory.

4. Modification of Heating, Ventilation and Air-conditioning System..... 345,000

This project provides for the modification of the existing mechanical system serving the high-bay clean room in the Environmental Laboratory, Building 144, to provide precise humidity control. This clean room is used to perform vibration tests on flight hardware, primarily large subsystems and spacecraft. It is currently being used to test the Galileo flight spacecraft. Typical humidity requirements for flight programs range from a maximum of 55 percent to a minimum of 25 percent relative humidity. Recently, local ambient conditions have caused the humidity to exceed 70 percent in this clean room. Presently there is no effective means to reduce the relative humidity to within acceptable levels. As a result, spacecraft such as Galileo have to be "bagged" and put under a purge system. This laboratory will continue to be used for future programs and a precise humidity control system is essential.

E. Johnson Space Center (JSC)..... 3,865,000

1. Modification of Shuttle Mission Simulator Complex..... 550,000

This project provides for modifying approximately 3,100 square feet of space in Building 35 of the Shuttle Mission Simulator Complex to accommodate a new replacement computer system. The existing system is obsolete and increasingly unreliable. This system supports software development and simulator interface testing. Work includes providing necessary computer flooring, fire detection, air-conditioning and electrical systems.

2. Modification for Advance Avionics Systems Development.. 700,000

This project is necessary to modify and rearrange several areas in the Shuttle Avionics Building (16) to accommodate the installation of new computer systems, engineering simulator and test equipment in support of the data management system, and advanced avionics systems development for Space Station applications. A mainframe computer will be installed in room 2012 to support software development, analysis, and interfaces for data management, displays, and controls systems. Room 1040 will be modified to establish a software support environment and test bed for the design and testing of displays and controls subsystems, the data communications system, and for overall Space Station systems engineering simulation. Work includes reconfiguring space and utilities, providing raised flooring, air-conditioning, electrical power, fire protection and other work associated with computer and data communication systems.

3. Rehabilitation of Anechoic Chamber..... 725,000

This facility is required for critical antenna testing in support of Shuttle sustaining engineering and Space Station communication test bed. The microwave absorber material in this chamber has been in use for 20 years and has suffered physical damage and deterioration to the point where testing is impaired. This project will replace approximately 18,400 square feet of the microwave absorber material. Replacement material will provide a higher degree of microwave absorption and will have a much higher fire retardant level than the existing material.

4. Modifications of Research and Engineering Data Processing Areas..... 700,000

This project provides facility modifications necessary for the installation of new computer equipment associated with build-up of the Engineering Computational Complex, in Buildings 16 and 17 and a data cable interconnection between these two data processing areas. The new research and engineering computing systems are necessary to support Shuttle sustaining engineering and Space Station engineering, system development and integration testing. Work in Building 16, includes providing approximately 270 feet of I-hour rated firewalls, establishment of a 320 square foot computer tape library and the normal air-conditioning and electrical power associated with the computer installation. In Building 17, approximately 175 square feet of computer flooring will be provided along with necessary air-conditioning and electrical power to accommodate the new computer equipment.

5. Rehabilitation of Aircraft Operations Facilities, Ellington Field..... 500,000

This project provides for general rehabilitation to the main hanger complex that services NASA's aircraft such as the T-38's and Shuttle training aircraft. These facilities were constructed in 1942 for the Army and have been in continuous use with only minimal maintenance and upgrading since that time. Work will include general renovation to the siding, hangar door rails, windows and doors, replacement of air-conditioning units and replacement of approximately 1,000 square yards of concrete aircraft mooring apron.

6. Modification of Photographic Waste Collection System... 690,000

This project provides extensive modifications to the photographic waste collection system located in buildings 8 and 8a to comply with federal regulations on underground hazardous waste tanks. The existing photographic waste collection system consisting of underground waste lines and underground concrete waste holding tanks must be replaced with above ground tanks to assure leak prevention/detection in accordance with hazardous waste regulations. Rerouting of the chemical waste lines, installation of waste transfer pumps and alarms and augmentation of the ventilation and exhaust system will also be provided.

F. Kennedy Space Center (KSC)..... 3,035,000

1. Rehabilitate Utility Annex Chiller..... 415,000

This project provides for the complete overhaul of refrigeration Unit 4 at the LC-39 Utility Annex. This unit provides air-conditioning to program critical facilities such as the VAB and OPF. The work includes rehabilitation of the 2790 HP motors, motor control center and exciter, cleaning gearboxes and heat exchangers, retubing of evaporators, compressor overhaul, and updating of the control panel. This project completes the overhaul of the LC-39 Utility Annex chillers which have been in continuous service since 1967.

2. Rehabilitate Pad A Switch Station..... 200,000

This project will refurbish Switch Station 902 (Pad A) which houses the 20-year old switch gear and transformers which have deteriorated due to the saline and launch environment. A washdown system will also be installed to protect the new equipment from the effects of corrosive combustion by-products released during launch by the STS vehicle.

3. Modify VPF Cooling Tower Capacity. 180,000

This project provides for the construction of a 400-ton ceramic cooling tower and installation of two 1,200 GPM condenser water pumps at the Vertical Processing Facility (VPF) to replace the existing cooling tower and condenser waterpumps. The cooling tower facilities provide a temperature-controlled environment for processing flight hardware, and are 20 years old. Originally, the equipment supported a lighter load but now must support higher heat loads necessitating a larger cooling tower.

4. Modify Air Compressors in Utility Annex..... 430,000

This project provides for the replacement of the two existing 350 HP air compressors at the Utility Annex with four state-of-the-art 100 HP compressors. These units will have a common progressive start/load-up system for efficiency. The existing compressors are 20 years old and spare parts are difficult and expensive to obtain. The compressed air is used to support pneumatic tools, equipment and many other systems in the OPF and VAB.

5. Modify Four Air Compressors in O&C Building..... 265,000

This project provides for the replacement in kind of four obsolete 40 HP air compressors and installation of two 60 HP air compressors. The new compressors are state-of-the-art and energy efficient with increased capacity. The existing compressors are worn and have been repeatedly rebuilt. They have passed-the point of economical repair and maintenance costs are excessive.

6. Modify Scape Facility Access Road to Pad A..... 645,000

This project will upgrade the road base and pave the existing dirt road between Pad A and the Self-Contained Atmospheric Protective Ensemble (SCAPE) Facility. It will also provide site development and expand utilities for the SCAPE Facility box cars/trailers. The new road will provide equal distance access to Pads A&B from the centrally located SCAPE Facility, thereby equalizing the "stay times" (time that emergency crews can stay at the pad) for SCAPE crew operations at both Pads. Equal "stay times" will eliminate the hazards and confusion of having different operational safety procedures for Pads A&B.

7. Modify Fire Protection System in Propellant Lab and High Pressure Gas Maintenance Facility..... 155,000

This project provides an automatic fire sprinkler water deluge system with fire cutoffs, and smoke and heat venting. Draft curtains will be installed throughout the Propellant Lab High Pressure Gas Maintenance

Facility. An automatic fire suppression system is required for the hazardous materials handled, such as propellant samples. Due to the numerous partitioned areas, it is very difficult for occupants to exit the facility quickly. The partitions also hamper fire fighting. The fire suppression system will provide the necessary protection for both personnel and the facility in the event of a fire.

8. Modifications for Life Science Support Facility... 745,000

This project provides for the modification of approximately 5,000 square feet of space adjacent to the existing Life Science Support Facility (LSSF) located in Hangar L, CCAFS. The modifications will provide a 2,000 square foot experiment/hardware mock-up and staging area, a 600 square foot bonded storage area, a 400 square foot electro/mechanical shop, two 400 square foot laboratory storage areas, and two large primate holding rooms of 250 square feet each. The additional space is needed to accommodate rapidly increasing life sciences experiment processing requirements. An experiment/hardware mock-up and staging area is needed to facilitate flight hardware turn around/processing between missions. A bonded storage area is needed for initial storage of experiment hardware between arrival at KSC and commencement of processing/integration with flight systems, and for storage of flight certified hardware to preclude the requirement of recertification. An electro-mechanical shop is essential for support of pre and post flight experiment processing and trouble shooting.

G. Langley Research Center (LaRC)..... 2,895,000

1. Rehabilitation of HVAC System, Computer Complex..... 745,000

This project provides for the partial rehabilitation of heating, ventilating, and air-conditioning systems serving LaRC's scientific computer complex. Work includes installation of free-standing air handling units in each computer room and supporting modifications to the utility systems. The air handlers and air distribution systems serving corridors and perimeter offices will also be upgraded. The computer complex requires uninterrupted control of temperature and humidity. Replacement of the large central air handlers with free-standing smaller computer room units will provide a higher degree of reliability and more flexibility in matching cooling capability to computer loads. The existing central air handling units are 25 years old, unreliable, and difficult to maintain.

2. Modifications for Integrated Problem Solving Laboratory... 250,000

This project modifies Building 1229 for an Integrated Problem Solving Laboratory of approximately 4,000 square feet for the installation of various computer and display equipment. The modifications will include: relocating existing windows, replacing exterior doors, installing a suspended ceiling with flush

mounted light fixtures, a computer deck floor, a new HVAC system, and upgrading the electrical distribution system. The area will provide space to house equipment used by research teams from government, universities and industry to investigate new ways to automate design decisions, to integrate design disciplines into unified systems, and to manage, evaluate, and store the exploding volume of design data.

3. Modifications for Advanced Technology Research Laboratory... 530,000

This project provides for the construction of a 3,500 square foot addition to Building 1200, and modification of the second floor and capacitor room of the existing building for gas laser research. Modification of the second floor will provide approximately 2,400 square feet of office space, and the existing capacitor room will provide approximately 3,000 square feet of environmentally controlled space. A potential breakthrough in space transportation and power transmission may be possible with a high powered, high-efficiency laser in earth orbit. The most promising candidate for such an application is the solar-pumped gas laser prototype developed by LaRC and demonstrated in October 1980. This research, now being conducted in the High Speed Aerodynamics Facility, is impeded by the operation of six wind tunnels which cause excessive vibration, humidity, dust, and temperature fluctuation in the laser test area. This project will provide the proper environment necessary for continued gas laser research.

4. Rehabilitation of Materials Processing and Developments Shop..... 420,000

This project provides for the rehabilitation of 12,800 square feet of shop, office and restroom areas in Building 1267A. The rehabilitation will include: the installation of insulated windows; roof replacement; HVAC upgrades; painting; conversion of restrooms with lockers and showers; and a 950-square foot addition to provide space that will include a conference room. Building 1267A houses LaRC's Materials Processing and Development Shop. The building is 24 years old and has never been rehabilitated. The facility is used to develop and test high-tech materials and related manufacturing techniques, which are essential on-going programs. The proposed rehabilitation is necessary because age and extensive use has resulted in the gradual deterioration of the facility which can no longer be corrected by routine maintenance. Installation of new windows and insulated roofing also will increase energy efficiency.

5. Rehabilitation of Research Aircraft Operations Building. 455,000

This project provides for the rehabilitation of approximately 62,000 square feet of office and laboratory space in Building 1244. The work includes: installing suspended ceilings with recessed light fixtures; new energy efficient windows; upgrading restrooms; painting interior walls; installing raised deck flooring; adding acoustical treatment; and installing a new fire protection system in the Experimental Avionics Integration Laboratory. The research aircraft operations building provides office and laboratory

space for approximately 300 research and operations personnel. This facility has not been upgraded since its construction in 1951. The deteriorated condition of this facility is such that normal maintenance is no longer cost effective.

6. Rehabilitation of CF_4 Tunnel..... 495,000

This project provides for the rehabilitation of approximately 15,000 square feet of laboratory space in the CF_4 Tunnel Facility in the Hypersonic Propulsion Test Area. The work includes modifications to an existing bridge crane, the rehabilitation of the vacuum pumping system, exterior walls, windows, roof, restroom facilities, interior walls, floor, ceiling, and improvement of the lighting and HVAC systems. The existing facility has had no significant modification or rehabilitation since original construction during 1960. The facility has seriously deteriorated and rehabilitation is necessary to restore building integrity.

H. Lewis Research Center (LeRC)..... 2,970,000

1. Modification to Electrical Systems, Material and Structures Building 400,000

This project provides for modifications to the electric power feeds and distribution systems in the Material and Structures Building (49). The work includes modification of the 2,400 volt systems; replacement of the existing transformer to increase system capacity; installations of a new 480-volt distribution switch board and redistribution of existing 208 volt loads to provide additional capacity for expansion. The present 480-volt and 208-volt systems are fully loaded. This project is needed to accommodate the increased electrical requirements to effectively support current and future research activities in this facility.

2. Modifications for Class 100 Clean Room, Model Preparation Building. 610,000

This project provides for modifications to approximately 1,000 square feet on the first floor of the Model Preparation Building (55) and the construction of approximately 200 square feet of new mezzanine area. The work includes the installation of a modular wall system, a 12-inch raised floor system, a laminar flow air system, a modular ceiling system and a 500 KVA transformer to replace the existing 300 KVA transformer. This project will provide a class 100 clean room to be used to develop materials, processes and component structures for use in the development of microwave integrated circuits to support advanced space communications requirements.

3. Modification of Tank 5, Engine Propulsion Laboratory. 695,000

This project provides for modifications to the space environment simulation facility, vacuum tank 5 in the Electric Propulsion Laboratory (301). The work includes installation of pumps, controls, and inert gas supply system, modifications to the existing liquid nitrogen and the cryogenic helium systems. This project will upgrade the facility space simulation capabilities and improve the operating conditions. These modifications are required to enable the facility to support the electric thruster engine research program.

4. Rehabilitation of Offices and Warehouses..... **650,000**

This project provides for the rehabilitation of the offices and warehouse area on the east side of Building **21.** The work includes replacement of the undersized air-conditioning system; upgrading of the lighting and electrical service systems; installation of four loading docks; rehabilitation of walls and ceilings; installations of insulation and other miscellaneous architectural work. Portions of this building were constructed in **1944.** Normal maintenance can no longer effectively keep the building in efficient .operation. This rehabilitation work is required to correct deteriorated conditions and improve the efficiency *of the warehouse operations. The existing plumbing and mechanical systems are very old and require frequent maintenance. These modifications will also greatly improve the overall thermal efficiency of this portion of Building **21** and will effectively reduce energy consumption costs.

5. Modifications to Propulsion Systems Laboratory..... 615,000

This project provides for modifications of the heater and turbo expander piping in Building **125** to allow transient range testing of engine systems. The work includes installations of four (4) electro-hydraulic valves; an added hydraulic system; one (1) exhaust muffler, piping modifications, control modifications and associated mechanical/electrical work. The combustion air supply system provides steady state test conditions with engine transients limited to rotational speed changes at a constant MACH number and altitude. These modifications will provide additional throttle valves and vents to allow transient numbers and altitude testing capability. Most engine system problems occur during transient operation.

I. Marshall Space Flight Center (MSFC)..... 3,840,000

1. Modifications of High Bay Assembly Facility..... 740,000

This project provides for modifications of the High Bay Assembly facility for Space Station Common Module Support Systems Integration. Work includes installation of the module docking adapter and enlarging the class **100,000** clean room by approximately 500 square feet. A two-ton overhead crane will also be

installed. An automated control system with a 250 KVA Emergency power supply system will be installed and connected to the various test control areas. Included are modifications to the simulators, environmental control, lighting, and electrical systems and the hazardous test area in Building 4620. This work is required to conduct subsystem and integrated system tests of life support equipment for Space Station.

2. Modification for Uninterruptible Power Supply in Laboratory and Office..... 545,000

This project provides for modifications to the Laboratory and Office Building 4487 A-Wing for the installation of a 400 KVA uninterruptible power system (UPS). The UPS will include static rectifiers and invertifiers, lead-calcium batteries for 10-minute operations, and related electrical and mechanical systems The UPS is required to provide a reliable source of electrical power to support SSME simulation systems. These systems are extremely sensitive to electrical power disturbances and a reliable source is required to prevent loss of data that would severely impact real time SSME flight hardware and software integration, engine test anomaly investigations, and launch support activities.

3. Modifications for Common Module Power Distribution System Test Facility..... 250,000

This project will modify approximately 12,000 square feet of space in Building 4475 to install a computer to support the Space Station common module power distribution system. Facility modifications include the replacement of walls, ceilings, installation of computer flooring, electrical power distribution, HVAC, fire protection, and related work. MSFC is responsible for the Space Station power distribution and management within the common module, and the modifications to Building 4475 are essential to provide space for the development, testing and definition of the common module power distribution system.

4. Modifications for Space Station One-G Simulator..... 365,000

This project provides for modification to support Space Station one-G simulation activities. The work includes partitions, raised floors, HVAC, compressed air for air bearings and electrical power for simulation ,equipment. Also included is related work for a workshop, observation platform and office space. These modifications are required to support the structural design and development of the Space Station. Without this facility, MSFC will not be able to meet commitments and schedules for the structural development and interface activities needed to support the Space Station program.

5. Rehabilitation of Surface Treatment Facility..... 670,000

This project provides for rehabilitation of the Surface Treatment Facility, Building 4760. Work includes the replacement of deteriorated liners in eight surface treatment tanks and foundations in six tanks,

pumps and piping. Also included is the installation of a 16-foot high by 20-foot wide insulated steel door, painting, modification to the HVAC and electrical power systems, and related work. Building 4760 provides surface treatment capability for metals used in various programs. Due to the corrosive nature of the environment, the building and industrial equipment have deteriorated significantly and emergency repairs are difficult. A delay in this rehabilitation work will result in a loss of capability provided by the facility with a significant impact on the support of programs such as Space Lab and Payloads, Space Telescope, and Shuttle.

6. Modification of Environmental Effects Facility..... 740,000

This project provides for modifications to 4,000 square feet of space in the Non-Destructive Evaluation Laboratory, Building 4605 for an environmental effects facility. Modifications include the installation of partitions, ceilings, 800 square feet of raised flooring for the instrumentation laboratory, office space, an electrical substation, emergency power and other related work. Four test cells will be provided with leadwall shielding, inert gas system, television and radiation monitoring. These modifications are required to evaluate Space Station materials with respect to long-term exposure to the space environment. The facility will provide the capability for simulated long-term space environment effects testing for the development of stable, long-life materials for Space Station application.

7. Modifications for Productivity Enhancement Laboratories..... 530,000

This project provides for modifications of 7,400 square feet of space in Building 4707 for productivity enhancement laboratories. Work includes the installation of partitions, ceilings, 500 square feet of raised flooring, lighting, and electrical power. Also included is a HVAC system to control the temperature and relative humidity, utilities, and high purity shop air. These modifications are required to provide a facility for the development of productivity enhancement techniques that will reduce the cost of space vehicles. These techniques will include the development of lightweight, high strength materials, improved manufacturing processes, advanced robotic development, and improved insulation, and data processing.

J. Michoud Assembly Facility (MAF)..... 2,010,000

1. Rehabilate the Columns, East Side Main Manufacturing Building..... 640,000

This project strengthens the ceiling support columns in the Main Manufacturing Building. Recent studies indicate that during high wind conditions, a significant number of columns in the Main Manufacturing Building (103) are overstressed according to contemporary structural design standards. The studies indicate that Building 103 is "safe" below 80 mph winds; however, the American National Standards Institute (ANSI) code

requires a 100 mph design standard. This project will upgrade the remaining column system to these standards. Work includes installing steel cover plates on columns and cross bracing in several locations. Rerouting of utilities and other structural modifications will also be accomplished. Work will be phased to cause minimal impact to on-going External Tank (ET) production activities.

2. Modifications to East Master Substation..... 535,000

This project is necessary to eliminate a potential single point failure in the electrical power distribution system at MAF. Electrical power is received via two (East and West) on-site master substations. The West Master substation has one 20-MVA transformer with one incoming feeder circuit. The East Master substation has two 20-MVA transformers but only one incoming feeder circuit. Should either of the existing incoming feeder circuits fail, MAF electrical capacity would be reduced by one-half. To improve this situation, a second, parallel incoming feeder circuit with associated switch gear and circuit breaker will be provided to the East Master substation.

3. Rehabilitation of Drainage System..... 600,000

During heavy rain storms, the Main Manufacturing Building (103) floods, causing equipment damages and production shut down. The drainage system for the roof of Building 103 (43 acres of surface) runs down interior drain lines located inside the building to under slab pipes, which in turn drain into the East borrow pit. This pit connects to the South borrow pit. Flooding is caused by rapid rise of water in the borrow pits which causes a back flow in the drainage system. To prevent flooding in Building 103, a detention weir will be provided in the South pit upstream of the pump station. This will detain water from entering the East pit and allow the pump station to maintain a lower elevation in the East pit and keep up with the flow. This project will also provide repairs to the underground storm drain lines in Building 103.

4. Rehabilitation of Clean Room..... 235,000

This project provides for the rehabilitation of the vacuum system, trichloroethylene degreaser and overhead handling system in the clean room located in the Main Manufacturing Building (103). The clean room area is used for cleaning and assembly of External Tank components typically requiring LO_2 compatibility, such as internal wire harness, lines and other hardware. The room's environmental systems are over 20 years old and need general rehabilitation. The vacuum system components, motors, fans and filters are mechanically deteriorated and require replacement. The trichloroethylene degreaser needs rework for proper ventilation of vapors. The overhead component handling system must be extended into two rooms for efficient movement of heavy components through the cleaning process and to prevent safety problems associated with manual lifting.

K. National Space Technology Laboratories (NSTL)..... 1,440,000

1. Rehabilitation to Fluid Component Processing Facility. 700,000

This project is necessary to improve the work flow, safety, and productivity of the Fluid Component Processing Facility, Building 2205. This facility provides repair, cleaning and testing services to high pressure gas and cryogenic system components for the Space Shuttle Main Engine (SSME) test facilities. Pneumatic testing of these components is conducted in open test cells located adjacent to Building 2205 and is exposed to wind, humidity, dirt, and rain. All test articles must be transported across an open air corridor (outside) for pneumatic testing in these cells. The service shop is operated 16 hours a day and has a work backlog of approximately 9,000 man-hours. It is further anticipated that service demands will increase by 50 to 60 percent in the near future to support the projected expansion of the SSME testing program. This project provides for enclosing the open air corridor and the existing test cells, remodeling the components service shop clean room area to provide direct access to test cells and a 3,000-square foot addition to accommodate reconfiguration of the existing processing area. Necessary temperature, humidity and contamination controls will also be provided.

2. Rehabilitation of High Temperature Hot Water Generation System 740,000

This project is required to improve the operating efficiency of the High Temperature Hot Water (HTHW) generation system for the Space Shuttle Main Engine (SSME) test area. The existing HTHW generators are oversized for the present load and are required to operate in an inefficient low firing rate range. This low rate of operation reduces the control span and the operating systems are no longer sensitive enough to maintain effective control. This project will correct this situation by providing a low temperature hot water system for space heating and reheating facilities within the SSME test area. The work will include the installation of a new boiler in the Test Control Center, Building 4110, the pumps necessary to move the hot water through 2,200 linear feet of new insulated supply and return lines to test stand A-1 and 3,100 linear feet of additional new piping and pumps to the test stand A-2. This project will also provide for all necessary ancillary equipment for the safe and efficient operations of the system.

L. Wallops Flight Facility (WFF)..... 1,430,000

1. Rehabilitate and Modify Second and Third Floors, Management Education Center..... 730,000

This project provides for the rehabilitation of the second and third floors of Building E-104 (14,000 square feet). The work includes installation of partitions and interior finishes to provide conference, classroom and office space, installation of toilet facilities, extension of the mechanical and electrical

systems to the second and third floors, modifications to the building ventilation system, and installation of an elevator. This work is necessary to provide the additional conference, classroom and support office space required by the NASA Management Education Center and for management and technical conferences, seminars, and retreats. The elevator will provide handicapped personnel access to the second and third floors.

2. Rehabilitate and Modify Boiler Plant..... 300,000

This project provides for the rehabilitation and modification of the Wallops Flight Facility main boiler plant, Building D-8. The project includes upgrading three unreliable 650 horsepower, 25,000-pound per hour boilers and the rehabilitation and modification of deteriorated 20-year old boiler plant piping, valving, and controls. The work is required for the continued safe and efficient operation of the main boiler plant. Deteriorated piping must be replaced and controls must be upgraded for increased reliability and energy efficiency. The three existing main boilers are 20 years old and require replacement and repair of tubes, cleaning, and the upgrading of burners for increased efficiency and improved reliability.

3. Rehabilitate Transmitter Facility..... 220,000

This project provides for the replacement of single pane windows and doors with thermal products; the sealing and repair of the concrete deck roof; the replacement of flashing; the sealing and painting of interior walls; and the installation of a sprinkler system throughout the building. This transmitter facility is a valuable asset to NASA that houses the command and destruct equipment and systems for WFF launches. It is also used for communications with the Space Shuttle program. The the 20 year old facility requires this work to arrest accelerating deterioration and reduce the risk of damage to key communications equipment.

4. Modify Technical Service Shop (F-10) Entrances..... 180,000

Building F-10 was constructed as an aircraft hangar in 1954 but has since been converted to a machine shop with associated support office space. The large hangar doors are repeatedly opened during the day to allow for the movement of equipment and supplies in and out of the building. The opening created by these hangar doors is much larger than is required to move the equipment. This results in an excessive loss of conditioned air from within the hangar every time the doors are open. Significant energy is lost and the working conditions in the building become uncomfortable. Of equal concern is the personnel egress from the north and south wing floor office space which is via exterior stairways exposed to the weather. These stairs become wet during rain, and collect ice and snow during the winter. This project will install an insulated curtain wall and a smaller-sized roll up door in the opening which presently contains the hangar doors. The second floor office entrance stairways will be enclosed to provide safe entrance and exit during inclement weather.

VARIOUS LOCATIONS	665,000
1. Modifications for Fire Protection, Canberra, Australia	665,000

This project modifies the deteriorated and obsolete fire protection equipment throughout the Canberra Deep Space Communications Complex for improved fire protection. The work includes the installation of electric and diesel driven fire pumps, and a 180,000 gallon water storage tank and associated piping. Also included is the replacement of obsolete fire detectors and installation of a central monitoring system to identify the location of a fire. A Halon fire suppression system will be installed in the equipment chambers of the DSS-42 and DSS-43 antennas. The present water supply system lacks the required pressure, flow capacity, and supply necessary for emergency fire suppression system throughout the complex. The detection system is unreliable, and lacks a central alarm panel system to alert operations personnel to the location of the fire. This project will bring the fire protection system up to minimum standards for assuring an adequate fire safety posture.

MISCELLANEOUS PROJECTS LESS THAN $150,000 EACH	680,000
TOTAL	30,000,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated $30,000,000 to 35,000,000 per year will be required for continuing rehabilitation and modification needs.

MINOR
CONSTRUCTION
OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

MINOR CONSTRUCTION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	495,000	CF 12-2
Goddard Space Flight Center	840,000	CF 12-3
Jet Propulsion Laboratory	430,000	CF 12-3
Johnson Space Center	450.000	CF 12-4
Kennedy Space Center	1.220.000	CF 12-4
Langley Research Center	645.000	CF 12-5
Lewis Research Center	485.GOO	CF 12-5
National Space Technology Laboratories	820.000	CF 12-6
Wallops Flight Facility	695.000	CF 12-6
Various Locations	870.000	CF 12-7
Total	7.000.000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE:	Minor Construction of New Facilities and Additions to Existing Facilities, Not in Excess of $500,000 Per Project
INSTALLATION:	Various Locations
	FY 1987 CoF ESTIMATE: $7,000,000
FY 1985: $5,000,000	FY 1986: $6,000,000

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for minor facility construction at NASA field installations and Government-owned industrial plants supporting NASA activities. Each project included in this program is estimated to cost not more than $500,000 and involves either the construction of new facilities or additions to facilities. The FY 1987 request of $7,000,000 will improve the usefulness of NASA s physical plant by changing the utilization of or augmenting the capabilities of various facilities. Included in this request are those programmatic and institutional projects that are essential to the accomp ishment of mission objectives.

PROJECT JUSTIFICATION:

The configuration of NASA's physical plant necessarily must respond to changes in utilization and adaptations required by changes in technology or in mission needs. Demands are generated by research, development, test, and similar activities. Specific justification for each minor construction project is provided under "PROJECT COST ESTIMATE."

PROJECT DESCRIPTION:

Included in the FY 1987 minor construction program are those facility projects for institutional or technical facility needs which could be fully identified at the time of submission of this budget estimate. Items of work totalling $7,000,000 are included in this resource request and have been distilled from a list totalling over $16,000~000. Projects were selected on the basis of the relative urgency of each item and the expected return on the investment. During the course of the year, rearrangement of priorities may require changes in some of the items to be accomplished. Such changes will be accommodated within the resources allocated.

These projects represent requirements that must be met in this time frame to support institutional needs and programmatic objectives. The following listing summarizes the cost distribution by category of work:

a. General Purpose Buildings.....1,320,000

b. Technical Buildings/Structures.....5,200,000

c. Pavements.....480,000

PROJECT COST ESTIMATE:

A.	Ames Research Center (ARC)	495,000
	1. Construction of Visual Display Laboratory (N-243)	495,000

Existing high bay space shall be reconstructed to provide two new floors of approximately 8,600 square feet, and adjacent space of approximately 5,600 square feet shall be modified to provide space required for a new Computer-Generated Imagery (CGI) systems laboratory. Basically two existing outdated Visual Flight Attachments (VFA's) are being replaced by new state-of-the-art CGI systems, and consolidation of other visual simulator laboratories are being relocated to consolidate functions for enhanced productivity. Without these modifications adequate floor space will not be available to support the enhanced integrated visual simulation programs now planned. Existing widely dispersed visual simulator laboratories will be consolidated into a single advanced imagery laboratory complex with supporting shop and office space. Modifications include structural and architectural, mechanical and electrical as required including independent HVAC systems with temperature and humidity control to support both new laboratory and computer areas.

B. Goddard Space Flight Center (GSFC) 840,000

1. Construction of an Addition to the Instrument Construction and Installation Laboratory 490,000

This project provides for the construction of a 2,750-square foot addition to the north side of the Instrument Construction and Installation Laboratory, Building 5, housing the Diffraction Grating Evaluation Facility (DGEF). This facility will evaluate diffracting gratings, (etched glass plate used as a prism) required for long range advanced astronomy and solar physics programs. Gratings must be evaluated for efficiency, incident and deviation angles, and resolution and scattered light, as a function of wavelength under the same geometrical conditions as those in which they will be used. No space is presently available to house the DGEF which, in addition to a clean environment, requires the installation of a 65,500 pound granite block, mounted on special vibration isolators. Foundations specifically designed to support this block will be provided. Present facilities are inadequate for efficient measurement of the variety of gratings required. This facility will have the capability to simulate all geometric configurations and greatly improve the accuracy, efficiency and effectiveness of this essential class of component testing.

2. Construction of Addition to the Plant Operations Building (4).. 350,000

This project provides for the construction of a 1,650-gross square foot addition to Building 4 which will include 1,300 square feet of laboratory space and 300 square feet for office/support space. The facility will include an ammonia detection and exhaust system, air-conditioning, utilities, and a fire detection and protection system. This facility is required to provide adequate space and utility services to operate the Space Station Instrument Thermal Test Bed and its ancillary equipment. The facility will provide contractors and users a laboratory in which to test and evaluate Space Station heat transfer systems and devices.

C. Jet Propulsion Laboratory (JPL)..... 480.000

1. Construction of North Lab Parking Areas..... 480,000

This project provides for the construction of approximately 250 new parking spaces adjacent to Corporal Road near Surveyor Road, and between Pioneer and Explorer Roads in the North Lab Area. This project is the first phase of parking development north of Explorer Road. Six obsolete substandard buildings (54, 55, 73, 85, 130, 188) totaling 13,000 square feet will be demolished in order to permit grading to create the new parking areas. All existing on-site and off-site parking areas are already fully utilized and new areas must be developed to accommodate personnel moving on-site from leased space. Included with the paved parking area development will be associated lighting, retaining walls, stairways, and landscaping within the parking complexes.

D. Johnson Space Center (JSC) 450,000

1. Construction of Maintenance and Operations Support Facility 450,000

This project provides for the construction of a new one-story building approximately 50 feet by 100 feet, to house maintenance and operation support services personnel and related functions. These functions are currently housed in overcrowded areas in Building 327 and in temporary areas on the second floors of Buildings 325 and 329. This project will allow personnel consolidation, improve performance and efficiency, and permit better use of space in Buildings 325, 327 and 329. The new building will be prefabricated metal on a reinforced concrete slab and contain office space for 35 personnel, a communications control room, a records storage area and a mechanical equipment room. Air-conditioning, heating, plumbing and electrical systems will also be provided.

E. Kennedy Space Center (KSC) 1,220,000

1. Construct Generator Maintenance and Storage Facility 490,000

This project provides for the construction of a 5,500-square foot generator maintenance and storage facility to support the Shuttle Processing Contractor (SPC). The existing generator facilities are being used by the Base Operations Contractor (BOC) leaving the SPC inadequate space and facilities. The generator maintenance and storage facility will provide the necessary space to maintain the 11 generators and 17 pieces of miscellaneous equipment now operated by the SPC in supporting operations at KSC and landing sites remote to KSC. This facility will replace two inadequate maintenance bays presently used by the SPC.

2. Addition to Launch Equipment Shed (LES) Facility 435,000

This project will enclose and air-condition a 30-foot by 40-foot shed at the east end of the LES building, and install a 5-ton overhead crane. A new 150-foot by 30-foot shed will be constructed along the south side of the LES building. Enclosing the existing shed will improve shop efficiency and working conditions by eliminating work stoppages due to inclement weather and the new larger structure will accommodate additional equipment and the increasing workload presented by Pad B launch activity.

3. Construct Hypergolic Maintenance Facility (HMF) GSE Storage 295,000

This project provides for the construction of a pre-engineered metal building which will provide 7,200 square feet of space to be used for the storage of aft propulsion subsystems, forward reaction control system (FRCS), installation fixtures with dollies, FRCS propellant tank removal fixtures, tank removal slings, tank

covers and miscellaneous items presently stored outdoors. Storage available at the HMF is inadequate and increased vehicle flow rates will require additional support equipment. Without this storage capability all GSE will continue to be stored outdoors which accelerates deterioration and increases cleaning and maintenance costs.

F. Langley Research Center (LaRC) 645,000

1. Construction of Carbon-Carbon Research Laboratory (1205) 490,000

This project will provide a 3,000-square foot materials laboratory addition to Building 1205. Langley is expanding its research capability in carbon-carbon materials, and the additional laboratory space is needed to house the required process equipment for materials fabrication. Presently, the equipment is located in various locations around the center. Productivity will be enhanced by locating all of the process equipment in one central location. The addition will match the existing structure, and will include all necessary HVAC, electrical, and plumbing.

2. Construction of Addition to Composite Model Development Shop (1238B) 155,000

This project will provide a 1,350-square foot addition to Building 1238B to provide a shop area for the development of advanced composites. This operation, which is environmentally "dirty" in nature, must be isolated from the existing lay-up shop, which requires a clean environment. The work will include a high strength slab to support heavy equipment such as a walk-in freezer, and installation of all necessary HVAC, lighting, and power.

G. Lewis Research Center (LeRC) 485,000

1. Construction of Addition to Control Room in 8-foot by 6-foot/9-foot by 15-foot Supersonic Wind Tunnel (SWT) Building (54) 485,000

This project provides for the enlargement and upgrading of the existing 8-foot by 6-foot and 9-foot by 15-foot SWT Control Room. The work includes the construction of an approximately 1,200-square foot control room addition with basement; installation of raised floor system throughout the control room; installation of a separate instrumentation system; installation of a new air-conditioning system; installation of a new lighting system; modifications of the electrical power and grounding systems, and miscellaneous architectural work. Both the 8-foot by 6-foot and 9-foot by 15-foot test sections are operated from a single control room. This enlargement will provide relief from current overcrowded conditions and will allow concurrent operations of both tunnel test sections.

H. National Space Technology Laboratories (NSTL) 820,000

1. Addition to Standards and Calibration Laboratory. 470,000

This project provides a 3,600-square foot addition to the existing Standards and Calibration Laboratory, Building 8110 to house new state-of-the-art automated, high precision standards and calibration equipment necessary to support the Space Shuttle Main Engine certification testing. The present facility does not provide the required dust, temperature, relative humidity and sound attenuation levels required for equipment calibration. The existing facility also lacks sufficient floor space, requiring laboratory instruments to be stacked on top of each other, thereby causing potential thermal instability. The addition will be environmentally controlled and will match the architecture of the existing building.

2. Addition to Earth Resources Application Building 350,000

This project provides for a 3,400-square foot addition to the Earth Resources Application Building 1210. NSTL has been assigned as Lead Center for the commercialization of the remote sensing technology. One of the primary objectives of the NASA commercialization program is to support industrial, university and government partnerships for cooperative research and development in the technical/scientific areas with high commercial viability. In order to support such partnerships, NSTL facilities and equipment must be available for industrial and university research. The addition is needed to provide space for both new data handling and processing equipment and for ADP equipment operators. The addition will be a pre-engineered structure to match the existing building. Work will include upgrading of the building electrical power system, carpentry, lighting and installing a sprinkler and HVAC system.

I. Wallops Flight Facility (WFF) 695,000

1. Construction of a Rocket Storage Facility 470,000

This project provides for the construction of a 5,000-square foot, single story Rocket Storage Facility. The building will be of metal panel fabrication with a 15-foot by 25-foot roll-up door, heating and ventilation. Due to the hazardous materials stored in the building it will be located in an area with natural earthen barricades and will be enclosed within a chain link fence. Rocket motors are currently being stored in six 40-year old magazines of 1,000 square feet each. These magazines have deteriorated and do not have sufficient structural integrity for continued storage of rocket motors.

2. Construction of Addition to the Mechanical Rigging Shop at the National Scientific Balloon Facility, Palestine, Texas..... 225,000

This project provides for the enlargement of the Mechanical Rigging Shop at the National Scientific and Balloon Facility. Additional space is required to meet the operational needs of the balloon program. This includes build-up, testing, checkout and certification of flight hardware including parachutes, cabling and gondola support items. Present quarters are insufficient to meet the increasing requirements of the program. The facility will be of pre-engineered metal construction of approximately 3,200 square feet on a concrete slab. This building extension will be equipped with standard utilities such as heating, ventilation and air-conditioning.

J. Various Locations..... *870,000*

1. Construction of Support Services Building, Merritt Island STDN Station, FL..... 420,000

This project provides for the construction of a 4,400-square foot administration and facility maintenance building at the Merritt Island Launch Area Spaceflight Tracking and Data Network (STDN) station. This building will provide space for facilities shops, ground keeping equipment, logistics and tape storage, and conference and training activities. It will replace an existing wood frame administrative building and two small metal buildings used as electrical and mechanical shops. The existing wood frame administrative building has deteriorated beyond economical repair. The two metal buildings are too small and have also deteriorated beyond economical repair. These buildings have no sanitary facilities and personnel must use restroom facilities in other buildings.

2. Construction of Antenna Support Building, Canberra, Australia..... 450,000

This project provides for the construction of a 4,300-square foot Antenna Service Building at the Canberra Deep Space Communications Complex and for the demolition of four temporary buildings now in use. This building will be located on the site of the temporary buildings and will be of frame construction matching the architectural theme of the Canberra complex. All required supporting services and facilities are included. The existing buildings lack sanitary facilities, appropriate fire protection systems, and thermal insulation; and low ceiling heights make it difficult to perform some of the maintenance tasks.

Total..... *7,000,000*

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated 7,000,000 to 10,000,000 per year will be required for continuing minor construction needs.

FACILITY
PLANNING AND
DESIGN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

SUMMARY

FACILITY PLANNING AND DESIGN

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CONSTRUCTION OF FACILITIES

FISCAL YEAR 1987 ESTIMATES

PROJECT TITLE:	Facility Planning and Design
	FY 1987 CoF ESTIMATES: $14,000,000
FY 1985: $12,000,000	FY 1986 $11,000,000

The funds requested in this estimate are required to provide for the following advance planning and design activities related to facilities activities and projects:

a. The accomplishment of necessary development and master planning for field installations and, where not otherwise provided for, the provision of continuing engineering support and special engineering management and other services.

b. The preparation of preliminary engineering reports, costs estimates, and design and construction schedules.

c. The preparation of final construction plans, specifications, and associated cost estimates and schedules required to implement construction projects.

d. The accomplishment of facilities siting and other investigations, studies and reports.

Regular requirements encompass the basic purposes outlined above. The "other requirements," while also in support of "regular" purposes, cover those special needs related to large, complex projects or specific programs considered to represent high potential future construction requirements for which early definition is essential. The large projects require more planning and longer lead time. Much of this planning must be completed prior to inclusion of the project in a budget request.

1. REGULAR REQUIREMENTS 9,300,000

A. Master Planning 330,000

Provides for update and development of existing field installation master plans. This effort includes facility studies, site investigations, and analyses of utility systems. The master plan document will be updated to reflect as-built conditions since issue of previous plans, and to graphically represent the five-year facility plan baseline for future development.

The NASA field center master plans are generally updated at four to five year intervals. On an agencywide basis, the level of effort remains fairly constant. The master plans are essential as reference documents for land use planning, physical relationships of facilities, and proper orientation and arrangement of facilities. Representative candidates for FY 1987 master planning are:

(1) Lewis Research Center

An update of the facilities inventory base to reflect new construction, utility system revisions, changes for additions to research missions, and revised five-year planning.

(2) National Science Technology Laboratories

An update to reflect new construction, revised land use planning, and changes to five-year planning.

(3) Michoud Assembly Facility

An update to reflect as-built conditions of facilities and utilities and revisions to land use planning.

B. Sustaining Engineering Support 1,520,000

Provisions for facility studies and specific engineering support continue in importance as evidenced in recent years, and must be given high priority throughout FY 1987. These efforts are important due to changing cost trends in construction materials and fuels; the continuing importance of energy conservation and efficiency; and the operation and maintenance costs for the physical plant.

The following items are included in the FY 1987 requirements:

(1) Building Research Board

Covers annual support to the Federal Construction Council's (FCC) operations and provides for special studies that the Council will perform throughout FY 1987 to help advance the science and technology of Federal Government building and construction. The FCC is subordinate to the Building Research Board, National Academy of Sciences, and its activities are supported by several Federal agencies including NASA.

(2) Utilities Services/Rates Analysis

Provides resources for the support of utilities procurement and utilities control systems. This includes, but is not limited to, technical assistance, surveillance, and recommendations with regard to utility rates, contract negotiations, systems operations, and utilities control systems. Because of the great magnitude of energy costs, these services are an annual requirement and continue to be essential.

These resources enable the Agency to insure that fair and reasonable rates are charged under its major utility contracts. Essential and valuable technical assistance is provided to our field installations so that effective negotiations can be conducted with utility companies. Several major utility contracts per year require technical assistance as utility contracts are renewed throughout the Agency.

NASA's significant ongoing investment in utility control and management systems requires a high level of technical maintenance and support. The proper function and operation of the equipment are essential in order to realize the benefits. These resources provide the high technical capabilities needed to manage the system and insure proper operation and use.

These resources will provide for an updating of our system for forecasting utility costs and rates, so that better and more reliable utility budget requirements can be established. The accuracy and credibility of forecasts impact the Agency's planning for other resources.

These and other similar utility system services are provided for by the requested resources in order to ensure technical competence and properly manage this function.

(3) Facility Operation and Maintenance Analysis

Provides for continued engineering support for implementing improvements at NASA field installations relative to manpower utilization, work control systems, preventive maintenance, facilities

management and reporting systems. Improvements will also involve techniques to identify where and how increases in productivity are possible. Included in this activity are field surveys to be conducted on a priority basis at selected NASA field installations to evaluate the effectiveness of the operations and maintenance management systems.

(4) Value Engineering Cost Validations and Analyses

Provides for engineering services to improve cost-effectiveness of facility projects by subjecting project design criteria, specifications and working drawings for specific material components and systems to a detailed independent review by engineering specialists in the particular area of involvement. Also provides services necessary to accurately predict and validate facility costs which will aid in resources planning for the various field installations.

(5) Facilities Utilization Analyses

Provides for the analyses of agencywide facilities utilization data covering: (1) office and other types of building space; (2) designated major technical facilities; and (3) special studies comparing the utilization of technical facilities which are similar in type or capability, such as wind tunnels. Such analyses provide for: (1) insights into and development of better methods of identifying underutilized facilities; (2) improved techniques to quantify level of facilities use; and (3) actions to improve facilities utilization. Work provides for review of each installation's inventory data base in support of the facilities utilization program. Surveys are necessary to validate the reported data in relation to a specific problem or need, and to assist in providing a credible foundation for plans to improve the utilization of facilities.

(6) Environmental Studies

Provides for the identification of potential environmental problems or the quick resolution of any related controversies at the NASA field installations. These conditions may be brought about by:

- New federal, state and local environmental regulations, emissions standards and environmental management planning programs that must be considered at various installations:
- Changes resulting from new or expanded program activities, new facilities, or major site expansions at NASA installations; and,
- Changes that take place in the external environmental conditions at NASA installations.

Early identification of potential environmental problems and quick resolution of these and related controversies at the installations are important. Project managers and facility planners require up-to-date, accurate information to comply with legal and regulatory requirements.

C. Preliminary Engineering Reports and Related Special Engineering Support. 2,450,000

(1) Preliminary Engineering Reports (PER's)..... (1,950,000)

Preparation of PER's, investigations, and project studies related to proposed facility projects in the FY 1989 and FY 1990 Construction of Facilities programs are provided for by this estimate. These reports are required to permit the early and timely development of the most suitable project to meet the stated programmatic and functional needs. Reports provide basic data, cost estimates and schedules relating to future budgetary proposals. This request provides for PER's; associated with proposed construction except as provided for in other requirements (paragraph 2) for Shuttle , Space Station, and Payload initiatives.

The estimated cost of PER support for FY 1989 construction projects is $1,300,000 which will permit updating of PER's for $30-35 million in construction, and the development of new PER's for an additional $40-50 million in projects.

An additional $650,000 has been included in this line for the completion of new PER's for approximately $30-35 million of construction projects which will be high priority candidates for inclusion in the FY 1990 Construction of Facilities program. The activity associated with FY 1990 will be confined to the highest priority candidates.

(2) Related Special Engineering Support..... (500,000)

Investigations and project studies related to proposed facility projects to be included in the subsequent Construction of Facilities programs are provided for by this estimate. Such studies involve documentation and validation of "as built" conditions, survey/study of present condition of such items as roofing and cooling towers, utility plant condition and operational modes, analysis and support of environmental impact assessments and statements, and other like studies. These studies are required to allow for the timely development of projects to meet the stated functional needs and to provide basic data, cost estimates and schedules for related future budgetary proposals.

D. Final Design 5,000,000

The amount requested will provide for the preparation of designs, plans, drawings, and specifications necessary for the accomplishment of projects other than Space Shuttle, Spacelab, and Payloads and the Space Station. Amounts required for those efforts are included under other requirements (paragraph 2). Projects involved are planned for inclusion in the FY 1988 and FY 1989 programs. The goal is to obtain better facilities on line earlier at a lower cost.

The request will provide for final design work associated with construction proposed for the FY 1988 Program, estimated to cost $65 to $70 million, and for $10 to $15 million of high potential projects proposed of the FY 1989 program. The amount included for FY 1988 candidates and for residual requirements of this nature which have accumulated from prior years' final design activities is $4,100,000. For FY 1989, $900,000 is included and the supporting rationale is much the same as that set out in the PER estimate.

2. OTHER REQUIREMENTS.. 4,700,000

Other facilities planning and design requirements primarily associated with specific space programs characterized by large size, long planning cycle, and/or complexity of scope are included in this particular request. These programs require a level of planning effort and length of design time beyond the more routine facility projects. These requirements must be provided beyond the regular and most recurrent facility planning and design needs.

A. Space Shuttle Facility Planning and Design ..... goo, 000

These resources provide for early and progressive design, final drawings, specifications, and site investigations for future Space Shuttle facilities in order to insure the best design, good cost estimates and realistic construction schedules. The Shuttle operational era requirements include expansion of Shuttle processing, repair and maintenance facilities to meet an increasing launch rate, construction of operations personnel facilities, modification to the launch complex support facilities and modifications at various locations for space engine enhancement and testing.

B. Payload Facility Planning and Design 600,000

Support of the operational phase of the STS payloads processing program will necessitate preparation of Preliminary Engineering Reports, facility site investigations, design of facility projects, and studies to determine facility capabilities. Included are facilities for payload operations and control payload

processing of the larger and more numerous payloads, as well as facility projects for logistics and maintenance of payloads and storage of associated flight and support equipment.

C. Space Station Support Facilities Planning and Design 3,200,000

This requirement is primarily for preparation of preliminary engineering reports and final design drawings, specification and associated site investigation required for construction of future Space Station facilities at various locations. Included are engineering and system management type test beds, data management, Mission Control Centers research laboratories, simulation, integration, processing and prelaunch checkout facilities.

Total $14,000,000

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